E. Cooney Associates, Inc.

Environmental Consultants

Via Hand Delivery

May 6, 2009

Mr. Michael Berkoff
Remedial Project Manager
U.S. EPA Region 5
Superfund Division
Remedial Response Section #2
77 W. Jackson Blvd.
Chicago, IL 60604-3507

Re: Driscoll Report/Lovejoy

Dear Michael:

I have attached a complete copy of Dr. Driscoll's expert report prepared for your review. This report demonstrates that the thickness of the clay till beneath properties south of Wisconsin Avenue, such as at the Lovejoy Property, and the absence of sand lenses there prevent infiltration of precipitation, the mechanism for contaminant migration to the underlying Silurian dolomite aquifer. As such, contaminant migration from shallow soil to the bedrock aquifer is prevented. I look forward to discussing our project with you this coming Friday.

If you have any comments or questions or would like to discuss this information further, please call.

Very truly yours,

Edward J. Cooney, Ph.D., P.E.

Attachments

Pc: N. Rich (without Attachment)

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Expert Report of Fletcher G. Driscoll, Ph.D.

In the matter of:

Ann Muniz and Ed Muniz et al.
Plaintiffs

Civil Action No. 04 C 2405

vs.

Rexnord Corporation et al.
Defendants

June 14, 2006

Prepared for
Katten Muchin Rosenman LLP

Prepared by
Fletcher Driscoll & Associates LLC

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Experience

My name is Fletcher G. Driscoll; I reside at 28 Peninsula Road, Dellwood, Minnesota. I received my B.A. degree in Geology from Carleton College, Northfield, Minnesota in 1955 and a Ph.D. degree in Hydrogeology from the University of Minnesota in 1976, with a Minor in Civil Engineering (hydromechanics). My academic research focused on the formation and wastage of ice-cored moraines in the Yukon Territory as a model for late-Wisconsin glaciation in the United States.

I am a Principal in the consulting firm of Fletcher Driscoll & Associates LLC. This firm specializes in providing regulatory support and expert witness services for issues relating to the investigation and remediation of Superfund sites throughout the U.S. At nearly all of these sites organic chemicals such as PCE, TCE and TCA are the principal chemicals of concern. Also, the firm has extensive experience in water and monitoring well design and construction technologies, groundwater and surface water modeling, and construction and mining dewatering. Previously, I was the Director of the Groundwater Division for Arcadis Geraghty & Miller, and professor at the Engineering and Applied Science Department of the University of Wisconsin (Madison), where I taught courses relating to the engineering aspects of water resources. Previously, I taught at the University of Minnesota (Minneapolis) and Carleton College.

I am chief author and editor of *Groundwater and Wells, 2nd Edition*, a 1,089-page textbook published in 1986 that focuses on important aspects of groundwater geology, well hydraulics, water well design and construction, well testing, and well rehabilitation. Over a 25-year period, I taught in over 500 professional training programs for scientists, engineers, lawyers, and state and federal employees. The National Ground Water Scientist and Engineers Association recognized me in 1987 for "outstanding contributions and achievements in enlightening the ground water community." The Wisconsin Water Well Association cited me for "leadership in groundwater protection" in 1991. I was elected a Fellow of the Geological Society of America in 1995. In 2002, I received a life membership in the National Ground Water Association based on my contributions to the groundwater industry. My resume is provided in Appendix A. Based on my training and nearly 35 years of experience, I believe I am qualified to offer opinions in this case.

Purpose

Fletcher Driscoll & Associates LLC was retained by the law firm of Katten Muchin Rosenman LLP on behalf of Lovejoy, Inc. to review documents related to the above-named case and to determine whether trichloroethylene (TCE) in soils at 2655 Wisconsin Avenue, currently occupied by Lovejoy, Inc. (Lovejoy Property), resulted in contamination of the bedrock aquifer. For the purpose of preparing this report, Lovejoy asked me to accept as true and correct all of the sampling data that I have reviewed in this case. A list of references is provided in Appendix B. The reference list includes documents reviewed by me in preparing these opinions.

Introduction

Groundwater originates mainly from the infiltration of precipitation, melting of snow, and recharge from streams and rivers. Once in the ground, water moves downward under gravity to the groundwater table, below which all void space is filled with water. The route infiltrating water takes through the unsaturated (vadose) zone to the groundwater table varies depending on the nature of the overlying materials. Primary soil parameters that control the rate of infiltration include the size and shape of the soil particles, uniformity of particle size, the extent of soil compaction, the degree of stratification, the presence of secondary porosity and permeability, and the extent of chemical precipitation or solution. In addition, the rate of infiltration is also affected by the volume of moisture introduced to the soil and whether the soil is frozen for part of the year. Thus, recharge to groundwater is highly variable over even small horizontal distances and, in fact, may not occur at all in some areas if the soils in the vadose zone are thick and have low porosity and permeability. When this happens, infiltrating water becomes perched above the regional groundwater table and no flow reaches the underlying groundwater table in the area.

Chemical wastes spilled or disposed to the ground can be carried downward with infiltrating water. The ability of the chemicals to move effectively through the vadose zone soils depends primarily on the solubility of the chemicals in water, the density of the chemicals (as pure product), their tendency to sorb to soil particles, whether they are volatile, and whether they attenuate by chemical or biological processes. Thus, movement of chemicals is controlled by multiple physical and chemical conditions in the vadose zone that determine whether, or at what rate, any chemical reaches the groundwater system.

The focus of this expert report will be to address the question of whether chemicals found in the soils at the Lovejoy Property ever reached the groundwater system. This analysis will then be tested by comparing conditions at the Lovejoy Property with conditions at other areas in the Ellsworth Industrial Park, as well as downgradient of the Park (Figure 1). Based on existing data it appears that differing hydrogeologic conditions in the Park have resulted in introducing various chlorinated solvents into the groundwater system in only a portion of the Park area.

Hydrogeologic Setting

Opinion 1 – Glacial sediments at the Ellsworth Industrial Park are of two types: 1) clayey, silty till and 2) sand and gravel outwash deposits. These sediments overlie a Silurian-age dolomite that is an important groundwater resource in DuPage County, Illinois.

Two primary geologic units underlie the Lovejoy Property and play a role in the occurrence and movement of groundwater.[1] The upper-most bedrock unit, a Paleozoic dolomite rock, is overlain by two types of glacial materials: clayey, silty till and outwash sands and gravels.

Silurian-Age Dolomite

The Paleozoic dolomite was deposited in shallow continental seas during Silurian Time, about 420 million years ago. This jointed and fractured bedrock unit is about 150 feet thick under the Ellsworth Industrial Park. Dolomite is usually created during a post-depositional alteration of limestone in which some of the calcium ions have been replaced by magnesium ions (Krumbein and Sloss, 1963). Upon withdrawal of the shallow seas, any younger rocks that may have been deposited over the Silurian rock later in Cambrian time have been completely eroded away in the Ellsworth Industrial Park area. Subsequently, the upper surface of the dolomite has been weathered and eroded for millions of years before continental glaciation began about 1.9 million years ago.

The typically low initial porosity and permeability characteristics of the Silurian (Niagaran) rock have increased over time, as the bedrock now serves as a productive aquifer. Although yields up to 1,500 gallons per minute (gpm) have been obtained, dry holes are not

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[1] The entire system of known rock units is presented in Zeizel, et al., 1962.

uncommon (Zeizel, et al., 1962; Woller, et al., 1986). Where the dolomite is at least 100 feet thick in the eastern part of DuPage County the specific capacities of wells range up to 80 gpm/foot of drawdown (Zeizel, et al., 1962). Because of over-pumping, water levels in the Silurian rock in Downers Grove (in 1960) were below the top of the rock. In Downers Grove, hundreds of residential wells have been installed into this bedrock aquifer.

Although long-term weathering of the dolomite has resulted in enhanced overall hydraulic characteristics, the spatial distribution of these effects is chaotic. Vugs or other large solution openings, for example, may occur in an otherwise tight rock and cause any groundwater in these voids to flow in directions that are not consistent with the overall hydraulic gradient, which in this area is to the south-southeast.[A,2] In general, groundwater flow is controlled by fractures or dissolution channels in the rock as well as by the hydraulic gradient. The groundwater flow direction may change locally when the water table rises or falls substantially as different parts of the rock hold different volumes of water. Clays that typically form on low relief surfaces of the dolomite can also inhibit vertical infiltration of precipitation in some areas.

The Illinois Environmental Protection Agency (IEPA) conducted sampling of the residential wells in an area south of the Ellsworth Industrial Park in 2001 and found many of the samples contained low concentrations of chlorinated solvents. The U.S. Environmental Protection Agency (EPA) in conjunction with IEPA began an investigation of the Ellsworth Industrial Park area to identify the source(s) of the chlorinated solvents. The Village of Downers Grove extended its municipal water system to serve this area and the residents are no longer using groundwater from the bedrock aquifer.

The spatial non-uniformity of the porosity and permeability of the rock presents challenges to tracking the origination and movement of contaminants in groundwater, especially in the absence of extensive data.[B] The large number of data points in the residential area, however, makes it possible to track the movement of the various solvent plumes in spite of the non-uniform distribution of pore space in the rock.[C] The same cannot be said for plumes in the Ellsworth Industrial Park where few data points in the Silurian rock provide guidance for plume tracking. Nevertheless, a careful analysis of the character of the overlying glacial sediments offers insights on where contaminants could enter the dolomite.

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[2] Letter notations refer to endnotes.

Glacial Sediments

At least four periods of glaciation have occurred in the last 1.9 million years. The most recent glacial period began about 50,000 to 70,000 years ago. The glacial till and sands and gravels left by advances and retreats of the Michigan lobe now cover the Silurian rock beneath the Ellsworth Industrial Park. The Great Lakes' basins provided flow paths for lobes extending southward from the main Laurentide ice mass. During glacial maxima, the ice in the Michigan basin flowed out of the basin southward. As the ice front moved out of the basin, a proglacial outwash plain consisting of sands and gravels was deposited on the existing land surface in front of the advancing ice by melt-water streams flowing off the ice front. A thin layer of lodgement till melted out of the bottom of the ice as the lobe advanced over the proglacial outwash plain. At some point the ice reached a locality where ice flow equaled, more or less, the melting rate thereby producing a stillstand of the ice terminus. During the initial stillstand and successive recessional stillstands the ice front would be more or less stationary for a number of years. Glacial till would continue to melt out of the ice as ice flow continued during the stillstand. Till consists of fine to coarse material without any sorting of particles. Thus, clay-rich till has an inherent low porosity and permeability. If the till is sandy, or contains many sand stringers its porosity and permeability increases. As the till melts out at the ice front a moraine forms which later becomes a linear ridge or hill bordering the former ice front. Till thickness at the Ellsworth Industrial Park exceeds 100 feet in places on the south end of the Park, but thins to the north. The moraine at the Ellsworth Industrial Park is part of the Valparaiso Moraine System and consists principally of the Wadsworth Till Formation, a clayey, silty till.

At the same time that a moraine is forming, meltwater flows off the ice depositing sands and gravels in front of the moraine in a feature called an outwash plain. Sometimes, so much ice melts during the summer a lake can form on the outwash plain, often between two moraines. If this lake becomes deep enough, the water can overtop the moraines as the ice retreats. Because the morainic sediment is only loosely consolidated it can be easily eroded by the outlet streams. Eventually, these stream channels become filled with sands and gravels, largely replacing the till. In the Ellsworth Industrial Park area the orientation of these ephemeral channels was toward the Michigan basin and transects the recessional moraines from west to east. St. Joseph Creek runs along one of these former alluvial channels in the Ellsworth Industrial Park and is underlain by sand and gravels, which, at some locations, extend all the way to bedrock (40 to 50 feet). This sand and gravel deposit is called the Henry Formation (Weston, 2006). Thus, the two principal types of glacial sediments at the Ellsworth Industrial Park are a massive clayey, silty till formation and sand and gravels that occur in both the thin underlying outwash plain and the cross-cutting linear alluvial deposits.

Infiltration of Precipitation

Opinion 2 – The thickness of the till at the Lovejoy Property, its low hydraulic conductivity and the absence of sand lenses prevent infiltration of precipitation to the underlying Silurian dolomite aquifer. In contrast, the dominance of sands and gravels along St. Joseph Creek provide an area where infiltrating precipitation can recharge the bedrock aquifer system effectively.

Infiltrating precipitation (rain water and meltwater) travels downward through the pore spaces of the surficial sediments. The connections between pore spaces in sands and gravels are relatively large in comparison to the clayey, silty tills like those found in the southern portion of Ellsworth Industrial Park. The difference in the size and connectivity of the sediment pore spaces determines the ease with which water can penetrate the sediments and ultimately reach an underlying groundwater aquifer. Although there is a broad range of hydraulic conductivity values depending on the specific dimensional and depositional characteristics of sediment, glacial tills have hydraulic conductivities several orders of magnitude lower than those for sands and gravels (Freeze and Cherry, 1979).

Stratigraphy at the Lovejoy Property

The glacial deposits beneath the Lovejoy Property are 90 to 100 feet thick. Most of these sediments consist of the Wadsworth Till, although it is possible that the till is underlain by a sand (outwash plain) layer which lies on the Silurian rock. The estimated thickness of the till formation is at least 65 to 80 feet; only three or four thin sand lenses have been identified in the till itself near the Lovejoy Property (Figure 2).

Some secondary porosity can be generated in till units by the presence of fractures created by weathering, such as freeze/thaw cycles or desiccation of the clay (Brockman and Szabo, 2000). Fractures are common near-surface features in some till units, but generally decrease in size and frequency with depth where the permanent moisture content of the till is high enough to prevent their formation (Brockman, 2000; Ruland et al., 1991).[D] Closely spaced fractures in the till can create a zone of increased groundwater occurrences near the surface, but below approximately 15 to 25 feet, fractures are typically non-existent or are so widely spaced that they are not well-connected to other fractures. The deepest reported fractures in the Wadsworth Till member at Argonne National Laboratory and Palos Forest Preserve, seven miles southeast of the Industrial Park were 25 and 15 feet respectively (Biang et al., 1994 and Olimpio, 1984).

Till fractures are present beneath the Lovejoy Property based on the occurrence of small volumes of unconnected groundwater at shallow depths. Below a depth of 28 feet, however, where shallow groundwater samples have been collected at Lovejoy, an additional thickness of at least 35 to 40 feet of low-permeability till exists. Thus, it appears that at Lovejoy and other locations in the southern portion of the Ellsworth Industrial Park, a significant thickness of low-permeability till (without any significant fractures) exists below the upper 15 to 25 feet of surficial till. This thick sequence of tills prevents the infiltrating precipitation water from reaching the bedrock aquifer system.[E]

Stratigraphy in the Area of St. Joseph Creek

In contrast to the thick till unit in the southern portion of Ellsworth Industrial Park, the glacial sediments beneath and near St. Joseph Creek consist of outwash sands and gravels. Although the thickness of these sediments varies and is sometimes interrupted by the presence of lenses of silt and clay, the sands and gravels can be more than 40 feet thick. In some places the alluvial sediments extend from the surface to the bedrock.

An aquifer exists in the sand and gravel deposits that parallel St. Joseph Creek. The EPA has assigned the term 'intermediate' aquifer zone to this occurrence of groundwater in order to distinguish it from the bedrock aquifer below as well as the somewhat higher perched groundwater that is found in some areas. The intermediate aquifer is limited to the lateral extent of these sand and gravel deposits and has not been identified in the clayey, silty till deposits found farther to the north and south in the Ellsworth Industrial Park area. Potentiometric heads measured at nested well locations demonstrate a general downward hydraulic gradient, indicating communication is likely with the underlying bedrock aquifer (Weston, 2006).[F] Woller et al. (1986), states that where saturated sand and gravel deposits directly overlie the Silurian dolomite, as is the case in much of the area where the intermediate aquifer is identified, the exchange of water from the glacial drift to the bedrock is enhanced.

The EPA (Kay and Ryan, 2004) reported a geometric mean hydraulic conductivity of 4.96 ft/day for wells completed in the intermediate aquifer. This geometric mean value, however, was calculated from slug tests performed in wells screened through both coarse-grained (sand and gravel) layers and fine-grained (silt and clay) layers. Thus, most hydraulic conductivities from these tests represent the hydraulic character of a combination of coarse-grained and fine-grained sediments. Only two wells tested, BD-1I and SB-17I, are screened primarily (80 percent or more) in sand. The conductivity value determined from BD-1I testing is 5.29 ft/day and the value from SB-17I is 79.6 ft/day. The much higher conductivity from SB-17I is the result of lower clay content in the sand encountered by that well and provides a good representation of hydraulic conditions where clean, well-sorted sands occur in the Industrial Park.

Vulnerability of the Bedrock Aquifer

Opinion 3 – The bedrock aquifer beneath the Ellsworth Park Industrial Area is vulnerable to contaminants released in the area along St. Joseph Creek because

- *coarse-grained alluvial sediments exist generally in this area,*
- *the hydraulic conductivity of these sediments is high compared to till,*
- *the glacial till deposits (if they exist) are thin, and*
- *depth to bedrock along the creek channel is limited compared to most areas where the till is deposited.*

The thick (60 to 80 feet) of clayey, silty till along the southern boundary of the Ellsworth Industrial Park prevents chemical releases at facilities located in this area from reaching the bedrock aquifer.

The vulnerability of the bedrock aquifer to contamination migrating from facilities in the Ellsworth Industrial Park is based on three factors; 1) the depth from the ground surface to the bedrock, 2) the presence and thickness of the till, and 3) the presence and thickness of coarse-grained sand and gravel units separating till layers. The topography in the Park varies from a low of 690 feet above mean sea level along St. Joseph Creek to a high of approximately 770 feet above mean sea level in the southwestern portion of the industrial park (Figure 3). Topographic highs occur along the southern edge of the industrial park and lower elevations occur along St. Joseph Creek and along a small tributary which runs north along Janes Avenue toward the Creek. As a result, the depth to bedrock is lowest along St. Joseph Creek (approximately 45-50 feet), and appears to be greatest along the southern and southwestern edge of the industrial park (approximately 70 to 80 feet), and even thicker in the residential area south of the industrial park (up to 136 feet).

<u>Thickness of the Glacial Materials</u>

To determine the thickness of the glacial materials overlying the bedrock it was necessary to estimate the elevation of the bedrock in the area of Ellsworth Industrial Park. Depth-to-bedrock information was obtained from boring logs and contoured using the natural neighbor method in Surfer®.[3,G] The resulting interpolated map was checked against actual data points and is presented in Figure 4. The thickness of the glacial overburden was estimated at each sampling point by subtracting the contoured bedrock elevation from the surface elevation. The resulting data were contoured by hand and checked using Surfer®; the map of the estimated thickness of the overburden is shown in Figure 5. The thickness of the glacial materials beneath the Lovejoy Property, which consist mainly of till, is greater than 90 feet. In contrast, the thickness of the glacial materials beneath St. Joseph Creek, which consist mainly of sands and gravels, is less than 60 feet.

Percent Fine-Grained (Till) Sediments

In order to compare the stratigraphy from different areas of the industrial park, the descriptions from soil boring logs were used to calculate the percentage of glacial sediments composed of till (fine-grained sediments with low permeability) versus sand and gravel (coarse-grained sediments with high permeability). The deepest boring logs were used in each area to minimize any bias that may be introduced by the lack of information at depth throughout the park area. The data were contoured by hand and checked using Surfer® (Figure 6).

The highest percentage of sand and gravel occurs north of Curtiss Street and east of Walnut Avenue, extending, on average, about 150 feet north and south of St. Joseph Creek. The width of the area increases to the east and extends as much as 800 feet north of the creek in some areas. The highest percentage of fine-grained materials occurs south of Wisconsin Avenue, particularly in the western portion of the industrial park. Along Janes Avenue and roughly following a tributary to St. Joseph Creek, there is a small area with a greater percentage of coarse-grained sediments than found in other areas along the southern edge of the park.

Vulnerability of the Bedrock Aquifer to Contamination

Depth to bedrock and percentage of fine-grained sediments data were used to prepare a map indicating the areas in the Ellsworth Industrial Park where the bedrock aquifer is vulnerable to the infiltration of water and, ultimately, to contamination that is released on the surface and carried downward.[4] By multiplying the percentage of fine-grained sediments and the thickness of the surficial materials, contouring the data by hand and checking the contours with Surfer®, a

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[3] Surfer® is a commonly used statistical analysis and contouring program developed by Golden Software, Inc.
[4] Berg and others have taken similar approaches in determining the vulnerability of aquifers in Illinois by assessing both the hydraulic character and depth to the uppermost aquifer (Berg et al., 1984; Berg, 2001).

map showing the estimated vulnerability of the bedrock aquifer was prepared (Figure 7). Areas underlain by thicker accumulations of fine-grained materials are less vulnerable to near-surface contamination reaching the bedrock aquifer. The vulnerability map shows that the areas where infiltration is most likely to reach the bedrock aquifer are located in the vicinity of St Joseph Creek, and that the lowest vulnerability occurs in the southern portion of the Industrial Park, including the Lovejoy Property.[H] Vulnerability appears to be somewhat higher in the vicinity of the tributary to St Joseph Creek along Janes Avenue than in areas to the west of this tributary.

Opinion 4 – Chemical sources located along St. Joseph Creek are responsible for groundwater contamination found in the residential areas to the south based on two lines of evidence: modeling of flow conditions and chemical transport through till and alluvium, and soil and groundwater data collected in and near the Park.

Chlorinated solvents dissolved in water will travel downward through the surficial sediments in the pore spaces of the sediments. The ability of the solvents to reach the bedrock aquifer is evaluated by first using a general model to estimate conditions similar to those found in the Ellsworth Industrial Park and secondly by analysis of the soil and groundwater chemistry to determine the likely source locations.

Vadose Zone Modeling Results

Fletcher Driscoll & Associates constructed two vadose zone models to compare the movement of chlorinated volatile organic chemicals (VOCs) through a cross section of sand to their movement through glacial till.[5] The code VS2DT 3.2 was used to construct the model scenarios. The VS2DT computer program was developed by the U.S. Geological Survey for solving primarily two-dimensional problems of water flow and solute transport in variably saturated porous media (Healy, 1990; Lapalla et al., 1987). The code uses the finite-difference method to solve a non-linear form of the Darcy equation for partially saturated flow and the advection-dispersion equation for transport. Unsaturated hydraulic characteristics are described by the van Genuchten equation for these two models (van Genuchten, 1980). Transport processes represented in these models are advection, dispersion, first-order decay, and equilibrium adsorption as defined by the linear isotherm.

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[5] Tom Davis of Fletcher Driscoll & Associates LLC performed the modeling work. His resume is attached in Appendix C. The modeling work was supervised by Fletcher Driscoll. The data files are available upon request. The modeling code is available at: http://wwwbrr.cr.usgs.gov/projects/GW_Unsat/vs2di/index.html.

Hydraulic and transport parameters used in both models are shown in Table 1. All parameters used were based on field data from the Ellsworth Industrial Park area, if available, or on representative literature values.[6] The general layout of the model conditions for the 'till scenario' represents a thick till unit comparable to that found near the southern boundary of the Industrial Park (Figure 8). The model layout for the 'sand scenario' represents a sand unit underlying a 5-foot till layer, similar to the conditions found in the Industrial Park along St. Joseph Creek (Figure 9). The VOC represented in both simulations is TCE. An initial soil-water concentration of 25,000 micrograms per liter (µg/L) is assigned to a simulated source area 5 feet wide by 1 foot deep in each model. This soil-water concentration is calculated from a sorbed soil concentration of 50,000 micrograms per kilogram (µg/kg) based on an equation from the IEPA Tiered Approach to Corrective Action Objectives (TACO). Infiltration is assumed to occur only six months each year. Each scenario is run to portray conditions at the end of 35 years.

The distribution of TCE concentrations at the end of each scenario is shown in Figures 10 and 11. In the till scenario, TCE concentrations of 5 µg/L reach a depth of 33 feet below ground. The maximum TCE concentration remaining in soil water at the end of the simulation is about 150 µg/L at about 23 feet below ground surface (bgs). TCE does not reach the estimated water table in the till simulation. For the sand scenario, TCE concentrations reach the water table in less than six years. No TCE remains in soil water at the end of the simulation, but a maximum concentration of 74 µg/L occurs just below the water table.[7] The difference in the modeling results can be attributed primarily to the following differences between the characteristics of the geologic materials:

- The saturated hydraulic conductivity for the sand is three orders of magnitude greater than for the till, causing more rapid vertical movement of dissolved TCE.
- The dispersivities in sand are three times those in till, producing greater vertical and horizontal spreading of TCE in the sand and a more compact, higher-concentration 'plume' in the till.
- The linear distribution coefficient is about an order of magnitude greater for the till than for the sand, causing greater adsorption of TCE to the till and restricting downward movement.

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[6] Observations made during model construction and testing indicate that the models are most sensitive to changes in hydraulic conductivity values and the chemical degradation rate. Because the model represents generalized conditions, model calibration and sensitivity analyses are unnecessary.

[7] No horizontal gradient is imposed on the groundwater flow system in the vadose zone model. Concentrations in groundwater would be lower because of advection and dispersion if a gradient had been assigned.

- The thickness of the vadose zone in the till scenario is about twice that of the sand scenario, preventing TCE from reaching the water table in till and allowing it to reach the water table rapidly in sand.

Although the modeling results are general in nature, they do indicate the substantial difference between VOC transport in hydrogeologic settings similar to those found at different locations in the Park. Where till is thin or not present at all, and sand dominates the sediments above the water table, VOCs may reach groundwater quickly, but leave low residual concentrations in soil and soil water. Where thick glacial till occurs above the water table VOCs may not reach the water table at all, even though residual soil and soil water concentrations may be higher than those observed in sand.

Soil and Groundwater Results

The results of the vadose zone models are corroborated by the actual soil and groundwater chemistry observed in the Ellsworth Industrial Park. In general, concentrations of chlorinated solvents in the till decline rapidly with depth to non-detectable concentrations. In contrast, concentrations of chlorinated solvents in the sand and gravel units have been detected at depths near the bedrock surface, indicating that contaminant transport occurs more readily through the sand and gravel units.

Although many of the highest concentrations of VOCs in soils were detected along the southern edge of the industrial park, the bedrock aquifer beneath these areas is less vulnerable (as has been shown) to contamination than in those areas along St. Joseph Creek having lower VOC concentrations in soils. At the Morey Facility located at 2659 Wisconsin Avenue, for example, concentrations of tetrachloroethene (PCE) as high as 220,800 μg/kg have been detected in the upper eleven feet of surficial soils. Yet, the PCE concentration falls rapidly with depth (Figure 12). No PCE has been found below a depth of 15 feet, which is approximately 80 feet above the top of the bedrock.

At an elevation of 730 to 740 feet above mean sea level at the Morey Site, there is approximately 90 to 100 feet of glacial sediments above the bedrock (Figure 2). A groundwater sample taken near the source area at a depth of about 64 feet below ground surface did not contain detectable concentrations of PCE (CPT58, <1 μg/L). Furthermore, PCE has not been detected in bedrock drinking water wells downgradient (south-southeast) of the Morey property, with the exception of one well located on Lomond Avenue with a low concentration of 0.256

μg/L. Thus it is evident that despite high concentrations of PCE in shallow soils, the thick sequence of till at this location has prevented the migration of PCE into the bedrock aquifer.[I]

In contrast, the stratigraphy farther north near St. Joseph Creek allows VOCs to penetrate to greater depths in the soils (Figures 13 and 14). At GP24, 1,100 μg/kg of TCE is present at 15 feet bgs, and 490 μg/kg at 37 feet bgs. At GP25, concentrations of 10,000 μg/kg TCE, 580 μg/kg PCE and 620 μg/kg TCA are present at a depth of 27 feet bgs. TCE concentrations higher than 100 μg/kg are found at depths greater than 35 feet at GP24, BD7, SB9 and BD5 (Figure 15). Furthermore, TCE concentrations higher than 200 μg/L are found within 20 feet of the bedrock surface at CPT50 (218 μg/L, approximately 6 feet above bedrock) and GP27 (260 μg/L, approximately 16 feet above bedrock). Finally, an estimated value of 0.56 μg/L of TCE was detected in the bedrock aquifer immediately south of these locations at BD5. Thus, it is clear that contamination in this vicinity has moved downward through the soil column, into the intermediate groundwater aquifer which is hydraulically connected to the bedrock aquifer. Although only a low concentration of TCE was detected in the bedrock aquifer, it is likely that the VOCs are transported laterally some distance in the intermediate aquifer because of intermittent fine-grained lenses before they are detected at higher concentrations in the bedrock aquifer farther to the south. These higher concentrations of TCE in the bedrock aquifer as well as the highest concentrations of TCE in the residential wells, originate near St. Joseph Creek where the bedrock aquifer is most vulnerable.

Restricted movement of TCE and PCE through the Wadsworth Till has been noted at the nearby Argonne National Laboratory Area 317/319 site located seven miles southeast of Ellsworth Industrial Park. At this site, 50 to 70 feet of silty, clayey till overlies the bedrock aquifer (Wescott et al., 1995). TCE and PCE have been detected in shallow soils at this site at concentrations ranging up to 47,000 μg/kg and 190,000 μg/kg respectively and in shallow (<30 feet bgs) groundwater at concentrations up to 8,600 μg/L and 50,000 μg/L respectively (U.S. EPA, 2003). TCE and PCE, however, have not been detected in groundwater samples collected from wells completed in the bedrock aquifer located 400 feet downgradient of the source area. (Golchert, et al., 1991, 1998, and 2000).

In summary, the thick till unit existing along most of the southern boundary of the Ellsworth Industrial Park prevents the downward migration of VOCs, whereas the sands and gravels in the area near St. Joseph Creek permit the transport of similar or even much lower concentrations of contaminants to the intermediate aquifer, and, ultimately, the bedrock aquifer. This contrast can be demonstrated by comparing the vertical extent of TCE concentrations in soil and groundwater in the till at the Lovejoy Property to those present in the coarser materials near

St. Joseph Creek (Figure 16). Similarly, source areas for PCE and TCA contamination in the bedrock aquifer are most likely situated over areas where the bedrock aquifer is vulnerable to contamination.

2655 Wisconsin Avenue Property (Lovejoy, Inc.)

Opinion 5 –TCE in soils at the Lovejoy Property has not entered the underlying bedrock aquifer. The TCE found in the bedrock aquifer in the residential area south-southeast of the 2655 Wisconsin Avenue property results from contamination reaching the aquifer upgradient of the Lovejoy Property.

The Lovejoy Property located at 2655 Wisconsin Avenue in the southwest corner of the Ellsworth Industrial Park is about 6.7 acres in size. The approximately 70,000 square-foot building on this property was constructed in the 1960s. Prior to that time, the land was farmland used for row crops (Mostardi Platt, 1997).

<u>Soil and Groundwater Investigation at the Lovejoy Property</u>

In 2003, as part of the EPA and IEPA investigation of the Ellsworth Industrial Park, soil and groundwater samples were collected at seven locations in the yard south and east of the Lovejoy building (Figure 17). Five of these samples did not contain detectable concentrations of chlorinated solvents. Two soil samples collected in the vicinity of the former chemical storage area at locations GP82 and GP83 contained concentrations of TCE at 25,000 and 35,000 μg/kg, respectively, at six feet below the ground surface. However, concentrations at these two locations decrease rapidly with depth. At GP82, concentrations decline from 25,000 μg/kg at 6 feet bgs to 9,500 μg/kg at 10 feet bgs, and are non-detectable (less than 10 μg/kg) at 17 feet bgs. Similarly, at GP83, concentrations decline from 35,000 μg/kg at six feet bgs to less than 10 μg/kg (non-detect) at 10 and 14 feet bgs (Figure 16). Shallow water samples collected from the vadose zone at 28 feet bgs from GP82 and GP83 contained 31 and 5.6 μg/L TCE, respectively.[J]

Although no borings were installed to the bedrock at Lovejoy, the depth to bedrock based on nearby deep wells and borings is estimated to be about 90 feet. Bedrock was not encountered just west of the Lovejoy property at CPT58, CPT80 and CPT81 at a depth of about 70 feet.

There is no indication that TCE concentrations detected in surficial soils or in the shallow water samples have moved either laterally or vertically from the source area to affect the bedrock aquifer. In fact, the attenuation rate of the TCE in the glacial till makes it improbable that any TCE could ever reach the bedrock beneath the Lovejoy Property. This conclusion is supported by the following bases established in this report:

- The low permeability of the clayey, silty till beneath the property inhibits downward penetration of precipitation and contaminants;
- Soil samples demonstrate attenuation to non-detectable concentrations by 17 feet beneath the ground surface;
- Studies at the Argonne Site indicate secondary porosity resulting from fractures in the Wadsworth Till is limited in depth;
- Water samples collected from the unsaturated zone at least 60 feet above the bedrock surface are low in concentration;
- More than 35 feet of low permeability, clayey, silty till exist below the deepest detection of TCE at the Lovejoy Property;
- Vadose zone modeling of similar hydrogeologic conditions demonstrates the inability of contaminants to reach the bedrock aquifer after 35 years of transport; and, finally,
- Higher concentrations of PCE at the adjacent Morey property under the same hydrogeologic conditions do not reach the bedrock aquifer as demonstrated by samples collected in the residential wells south of the property.

<u>Potential Sources Exist North-Northwest of Lovejoy</u>

It is of interest to identify the source of the low TCE concentrations found in the bedrock aquifer to the south-southeast of the Lovejoy Property.[K] It has been recognized that there is an effective hydraulic connection between the intermediate sand and gravel aquifer and the underlying bedrock aquifer in the Ellsworth Industrial Park area. Weston (2006), for example, states that saturated sand and gravel units immediately overlying the bedrock are in direct communication with the bedrock. Woller et al. (1986) goes further when describing conditions in DuPage County, stating that the free exchange of groundwater is enhanced as demonstrated by increased yields in the bedrock aquifer when overlying sand and gravel deposits are present. As stated earlier in this report, a sand and gravel unit parallels the course of St. Joseph Creek. Apparently, the aquifer found in these deposits beneath and near the stream course results from periodic infiltration from the Creek as well as from precipitation. This local aquifer has been termed the intermediate aquifer.

There is evidence of TCE in the intermediate aquifer just above the bedrock surface at locations upgradient (north-northwest) of the Lovejoy Facility. TCE was detected at 6 μg/L in

MW-1601S at a depth of 57 feet, about ten feet above bedrock. TCE was also detected at 9.2 µg/L in BD-4 and 3.1 µg/L in LD-1 in the intermediate aquifer at depths of 52 and 59 feet, respectively.[L] These samples were collected from the intermediate aquifer in a sand and gravel unit that is in direct contact with the bedrock. The bottoms of the screened intervals for these samples are within 6 feet or less of the bedrock surface (Figure 18).

Lateral transport occurs in the intermediate aquifer before contaminants reach the underlying bedrock aquifer. Unfortunately, there are no bedrock groundwater samples collected between BD-4D and the residential wells south of the Lovejoy Property to demonstrate this lateral transport. However, the concentration of 9.2 µg/L of TCE in the intermediate aquifer immediately above the bedrock aquifer can be correlated to the downgradient, low concentrations (less than 4 µg/L) of TCE found in the residential wells south-southeast of the Lovejoy Property. Little attenuation of concentrations occurs once contaminants reach the bedrock aquifer.

Nature of the VOC Plume in the Residential Area

The concentrations of TCE in the residential wells south of the Lovejoy Property represent a broad, low concentration plume. Plumes just downgradient of a typical source area are generally narrow and are usually characterized by high chemical concentrations. Dispersion causes contaminant plumes to broaden as they move away from a source area. The western portion of the TCE plume in the residential wells extends approximately 800 feet farther west than the TCA plume and about 1,000 feet west of the PCE plume. Because of its proximity to the residential wells, it would not be possible for a source at the Lovejoy Property to create such a broad plume, especially one in which the concentrations are so uniform. Instead, the source(s) for the broad, low concentration TCE plume is located some distance upgradient of the Lovejoy Property. It is most likely that the source(s) for the TCE are those present in the intermediate aquifer north-northwest of the Lovejoy Property in an area where the bedrock aquifer is more vulnerable to contamination.

I reserve the right to alter or supplement my opinions based on any additional information provided to me.

Fletcher G. Driscoll

Fletcher G. Driscoll, Ph.D.
June 14, 2006

Endnotes

[A] Siegel asserts in his expert report that the hydraulic properties of the Silurian-age dolomite under Downers Grove are similar throughout the region from Illinois to western New York (Siegel, D.I., Expert Report, December 20, 2005). The hydraulic properties of fractured carbonate formations, however, are highly variable even over short distances. Differential weathering, erosion and dissolution of the rock produce often dramatically different characteristics from one location to the next. Siegel's own analysis of hydraulic properties using specific capacity data from the domestic wells in the Class Area clearly demonstrates this high variability.

[B] Siegel indicates that the porosity of the Silurian dolomite is two percent. Locally, however, the porosity may be much higher where large openings occur in the bedrock. Because most groundwater flow occurs where higher porosity zones are connected, a significant underestimate of the rock porosity will produce a significant overestimate of flow velocity.

[C] Siegel first states that groundwater flow in the Silurian aquifer is to the southeast, however, later he says that "the composite solvent plume clearly moves northeast-southwest, consistent with regional direction for groundwater flow in the Silurian aquifer as shown by Zeisel [sic] and others (1962)." This is a clear contradiction and inconsistent with the data presented by Zeizel (Zeizel, 1962).

[D] Siegel declares that fractures occur "ubiquitously within clay-rich soils, commonly in at least the upper 20 feet." Although till fractures do occur in other nearby tills, they do not occur in all tills everywhere. The presence of fractures in the till beneath the Ellsworth Industrial Park has not been verified by investigation and they may not occur at all locations, especially to a depth of 20 feet.

[E] Siegel does not differentiate the areas in the Ellsworth Industrial Park where the greatest and least amounts of recharge are likely to occur. Rather, he seems to portray all areas similarly in terms of the how infiltrating precipitation moves through the glacial deposits.

[F] Siegel states that, based on *the rule of v's*, Figure 4-4 from the EPA Data Evaluation Report shows the St. Joseph Creek has no effect on vertical groundwater flow in the . Unfortunately, he describes the creek flow direction erroneously. He indicates that the creek flows generally from west to east, when in fact it flows from east to west. He also does not consider in his limited analysis that groundwater elevation contours shown in EPA's Figure 4-4 were based on data collected when the creek stages in DuPage County are generally at their highest. Furthermore, it is not at all clear whether the creek stage was even included when the data were contoured for EPA's figure. Nevertheless, some bending of the contours in Figure 4-4 is evident (with the v's pointing opposite to creek flow) suggesting that St. Joseph Creek may have a stronger influence on intermediate groundwater flow than suggested by Siegel.

[G] The Weston/EPA map presented in the Preliminary Planning Report (2006) was not used by Fletcher Driscoll & Associates because of errors found in Weston's interpretation of bedrock depths from two boring logs (SB-09 and BD-14D). Weston reported a bedrock elevation of 647.95 feet for SB-09, although the boring log does not confirm that bedrock was encountered. By subtracting the surface elevation from the boring depth, the maximum bedrock elevation is 640 feet, 8 feet lower than EPA's reported elevation. Because of the discrepancy in bedrock elevation, and the lack of confirmation in the boring log, SB-9 was not included in the bedrock elevation map. BD-14D was reported to have a bedrock elevation of 649.77 feet. However, subtracting the ground elevation of 699.77 feet by the depth to bedrock reported in the boring log (60 feet), the bedrock elevation is 639.77 feet, which was the value used to create the bedrock elevation map for this report.

[H] Bennett states in his expert report that he bases his conclusions about the Lovejoy Property on soil data and proximity to TCE concentrations detected in residential wells in the Class Area (Bennett, P.C., Expert Report, December 22, 2005). He ignores the hydrogeologic and physical conditions that limit the vulnerability of the bedrock aquifer beneath the property.

[I] Bennett includes the Morey site as a contributor to the bedrock VOC plume; but as a contributor of TCE not PCE. PCE concentrations in soil at Morey are much greater than TCE concentrations, yet he does not explain how only TCE concentrations reach the Class Area.

[J] Bennett asserts that "deep infiltration of solvent contaminants" has occurred at the Lovejoy Property. Considering TCE has been detected at a depth of less than one-third of the approximate depth to the bedrock aquifer, Bennett's statement is unverified.

[K] Bennett asserts that the TCE concentrations south-southeast of Lovejoy are "high" in the "western extension" of the TCE plume. Concentrations detected in most residential wells in this area are less than 4 μg/L with only one detection (5.84 μg/L) exceeding the MCL. Concentrations below or only slightly above the MCL cannot be qualified as "high".

[L] Bennett asserts that there are no possible sources upgradient of Lovejoy, contrary to the data.

Table 1. Vadose Zone Model Parameters for Both Till and Sand Scenarios
Ellsworth Industrial Park, Downers Grove, IL

Parameter		Std Units	Model Units	Basis
Horizontal Hydraulic Conductivity--Till	K_h	0.02835 ft/day	0.01 m/day	Berg et al, 1984; 1E-8 avg value for clay till X 1000 for fractures
Horizontal Hydraulic Conductivity--Sand	K_h	20.52 ft/day	6.3 m/day	Slug Test Data from SB-17I and BD-1I, Kay and Ryan, 2004
Horizontal Hydraulic Conductivity--Dolomite	K_h	0.86 ft/day	0.26 m/day	Slug Test Data from Bedrock Wells -- Kay and Ryan, 2004
Anisotropy Ratio for Sand	A	0.1		Driscoll, 1986
Vertical Hydraulic Conductivity--Till	K_v	0.02835 ft/day	0.009 m/day	Same as K_h
Vertical Hydraulic Conductivity--Sand	K_v	2.05203 ft/day	0.63 m/day	Calculated from K_h and anisotropy ratio
Horizontal Hydraulic Conductivity--Dolomite	K_v	0.86 ft/day	0.26 m/day	Same as K_h
Soil Bulk Density--Till	ρ_b	1.51 lb/ft3	1.51 g/m3	Basic Soils Engineering, Hough 1969
Soil Bulk Density--Sand	ρ_b	1.76 kg/L	1.76 g/m3	Basic Soils Engineering, Hough 1969
Organic Carbon Partition Coefficient	K_{oc}	166 cm3/g	1.66E-04 m3/g	Illinois TACO Appendix C, Table E
Organic Carbon Content--Till	f_{oc}	0.0108	0.0108	Morey Site data
Organic Carbon Content--Sand	f_{oc}	0.001	0.001	Estimated at 0.1 times Till value
Organic Carbon Content--Dolomite	f_{oc}	0.0001	0.0001	Estimated at 0.01 times Till value
Linear Distribution (Partition) Coefficient for TCE--Till	K_d	1.79 cm3/g	1.79E-06 m3/g	Calculated from K_{oc} and f_{oc}
Linear Distribution (Partition) Coefficient for TCE--Sand	K_d	0.166 cm3/g	1.66E-07 m3/g	Calculated from K_{oc} and f_{oc}
Linear Distribution (Partition) Coefficient for TCE--Dolomite	K_d	0.0166 cm3/g	1.66E-08 m3/g	Calculated from K_{oc} and f_{oc}
Initial TCE Concentration in Soil (Pore) Water--Till Scenario	C_{w0}	25 mg/L	25 g/m3	Calculated from 50,000 µg/kg soil conc. using TACO equations
Initial TCE Concentration in Soil (Pore) Water--Sand Scenario	C_{w0}	177 mg/L	177 g/m3	Calculated from 50,000 µg/kg soil conc. using TACO equations
Source (Initial Concentration) Width	W_C	5 ft	1.52 m	Estimated
Source (Initial Concentration) Depth from Ground Surface	H_C	1 ft	0.30 m	Estimated
Annualized Recharge/Infiltration	R	3 in/year	0.00021 m/day	Zeizel, 1962
Recharge/Infiltration for Each Six-Month Period	R		0.00042 m/day	Calculated from annual total
Attenuation 'Half Life' for TCE	HL	10 year	3652.5 day	Conservative value based on Howard, 1991
Decay Constant for TCE	λ	0.069 year^{-1}	1.90E-04 day^{-1}	Calculated from half life
Longitudinal Dispersivity--Till	α_L	0.3 ft	0.1 m	Gelhar, 1993
Longitudinal Dispersivity--Sand	α_L	1 ft	0.3 m	Gelhar, 1993
Transverse Dispersivity--Till	α_T	0.03 ft	0.01 m	Gelhar, 1993
Transverse Dispersivity--Sand	α_T	0.1 ft	0.03 m	Gelhar, 1993
Specific Storage--Till	Ss	0.00117 ft^{-1}	3.6E-04 m^{-1}	Domenico, 1972
Specific Storage--Sand	Ss	0.014 ft^{-1}	4.3E-03 m^{-1}	Domenico, 1972
Porosity--Till	η	0.4	0.4	Driscoll, 1986
Porosity--Sand	η	0.35	0.35	Driscoll, 1986
Van Genuchten alpha--Till	α	0.5	0.5	VS2DT defaults from van Genuchten, 1980
Van Genuchten alpha--Sand	α	4.31	4.31	VS2DT defaults from van Genuchten, 1980
Van Genuchten beta--Till	β	1.09	1.09	VS2DT defaults from van Genuchten, 1980
Van Genuchten beta--Sand	β	3.1	3.1	VS2DT defaults from van Genuchten, 1980
Residual Mositure Content--Till	RMC	0.07	0.07	VS2DT defaults from van Genuchten, 1980
Residual Mositure Content--Sand	RMC	0.02	0.02	VS2DT defaults from van Genuchten, 1980

References:

Berg, R. C., J.P. Kempton, and K. Cartwright, 1984, Potential for contamination of shallow aquifers in Illinois, Illinois State Geological survey Circular 532.
Domenico, P. A., 1972, Concepts and models in groundwater hydrology, McGraw-Hill, New York.
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Hough, B. K., 1969, Basic Soils Engineering, The Ronald Press Co., New York.
van Genuchten, M. Th., 1980, A Closed-form equation for predicting the hydraulic conductivity of unsaturated soils, Soil Sci. Soc. Am. J. 44:892-898.

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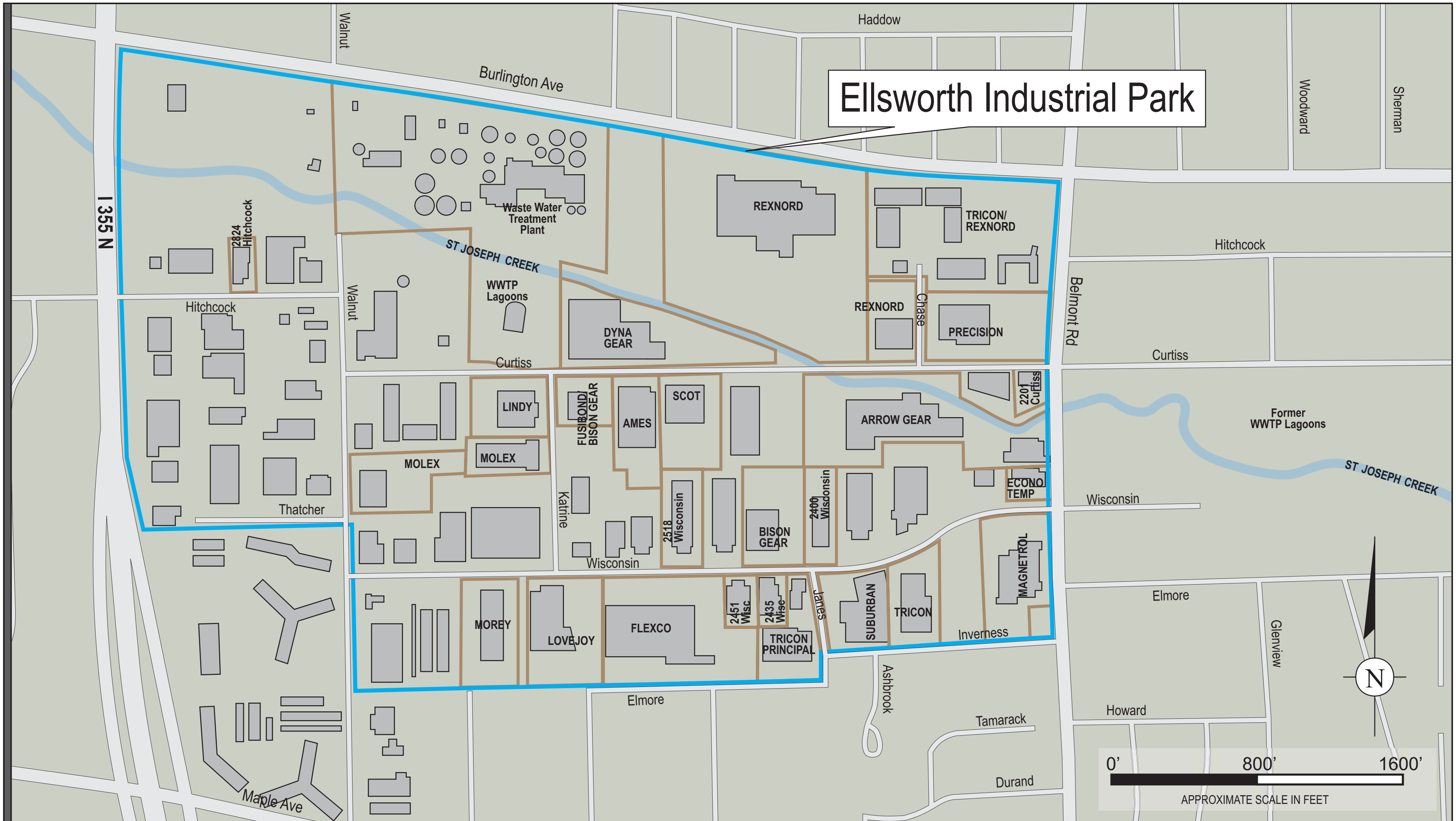

Area Map, Ellsworth Industrial Park

Downers Grove, IL

Figure 1

Fletcher Driscoll & Associates LLC

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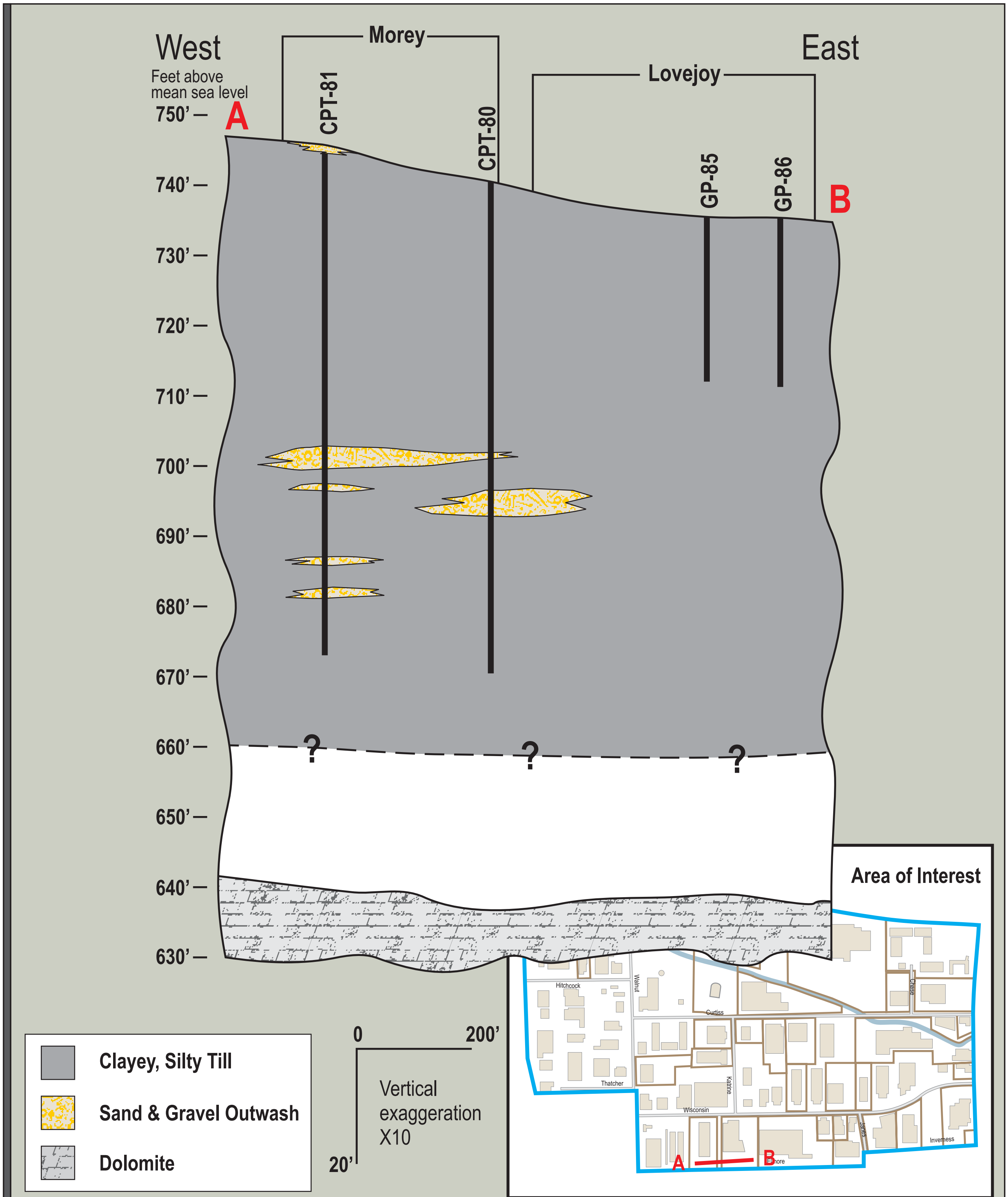

Geologic Cross Section at Morey - Lovejoy

Ellsworth Industrial Park, Downers Grove, IL

Figure 2

Fletcher Driscoll & Associates LLC

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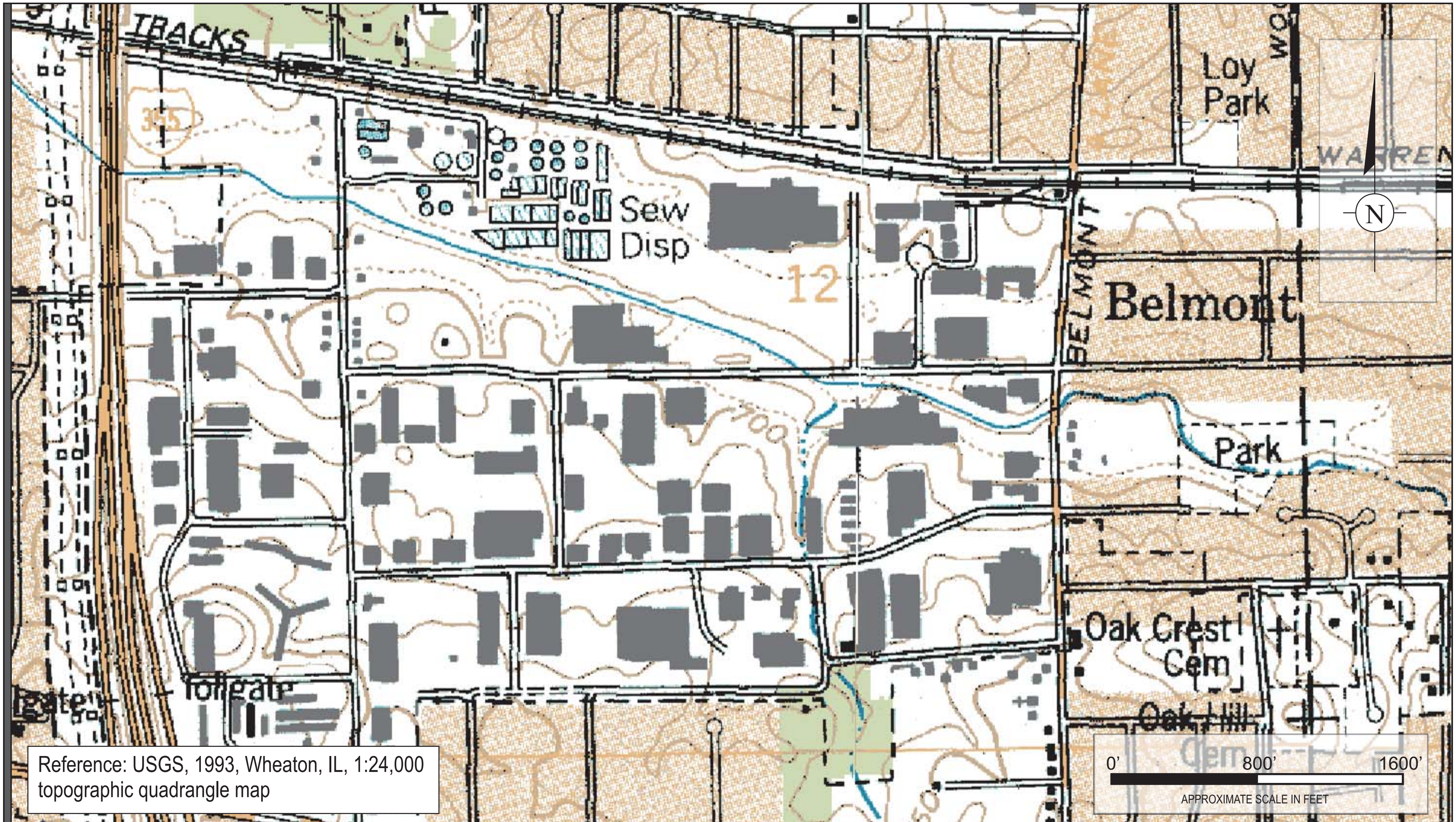

Reference: USGS, 1993, Wheaton, IL, 1:24,000 topographic quadrangle map

Area Topographic Map with Surface Elevations

Ellsworth Industrial Park, Downers Grove, IL

Figure 3

Fletcher Driscoll & Associates LLC

DRISCOLL 00041

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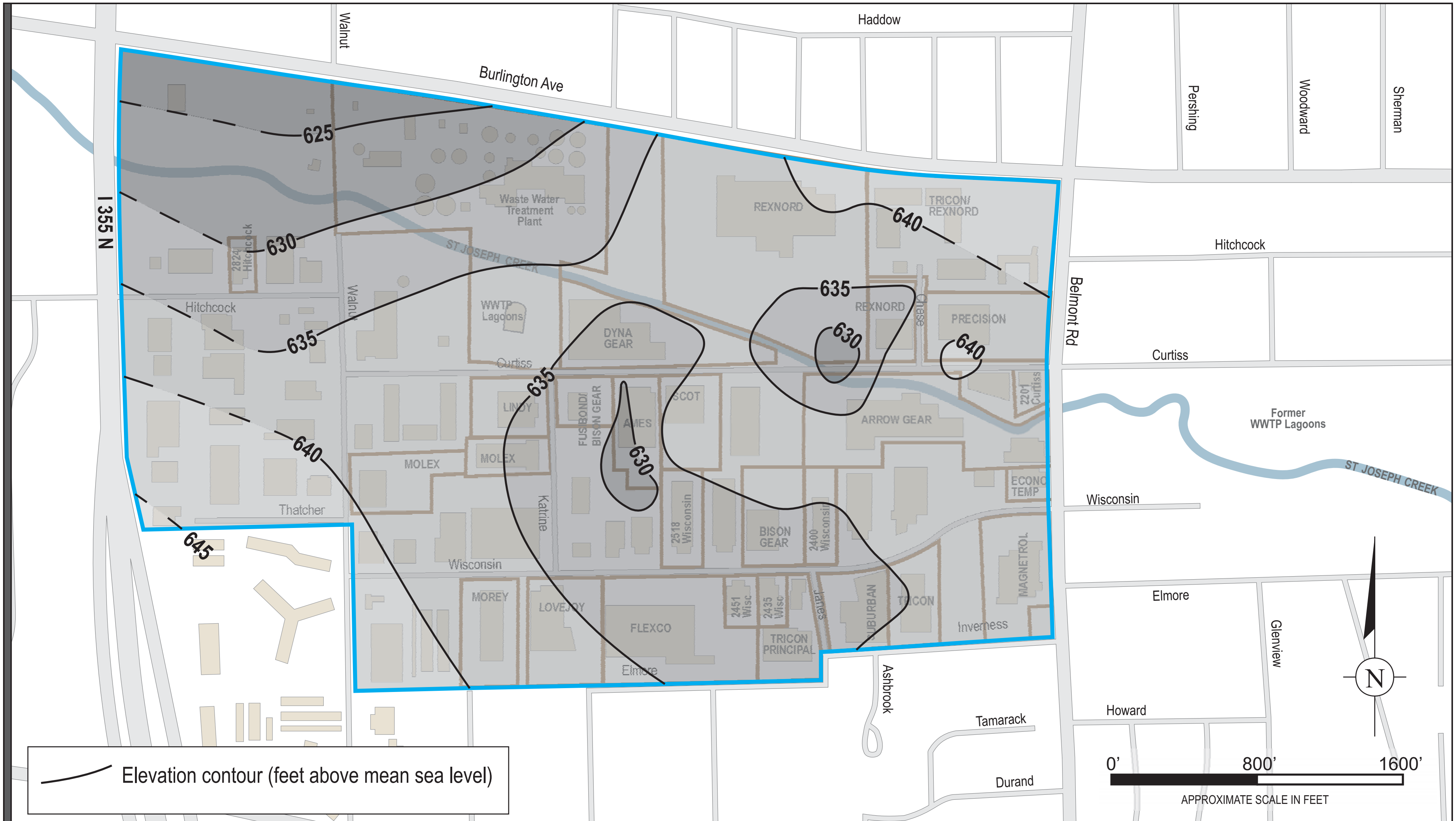

Estimated Bedrock Surface Topography

Ellsworth Industrial Park, Downers Grove, IL

Figure 4

Fletcher Driscoll & Associates LLC

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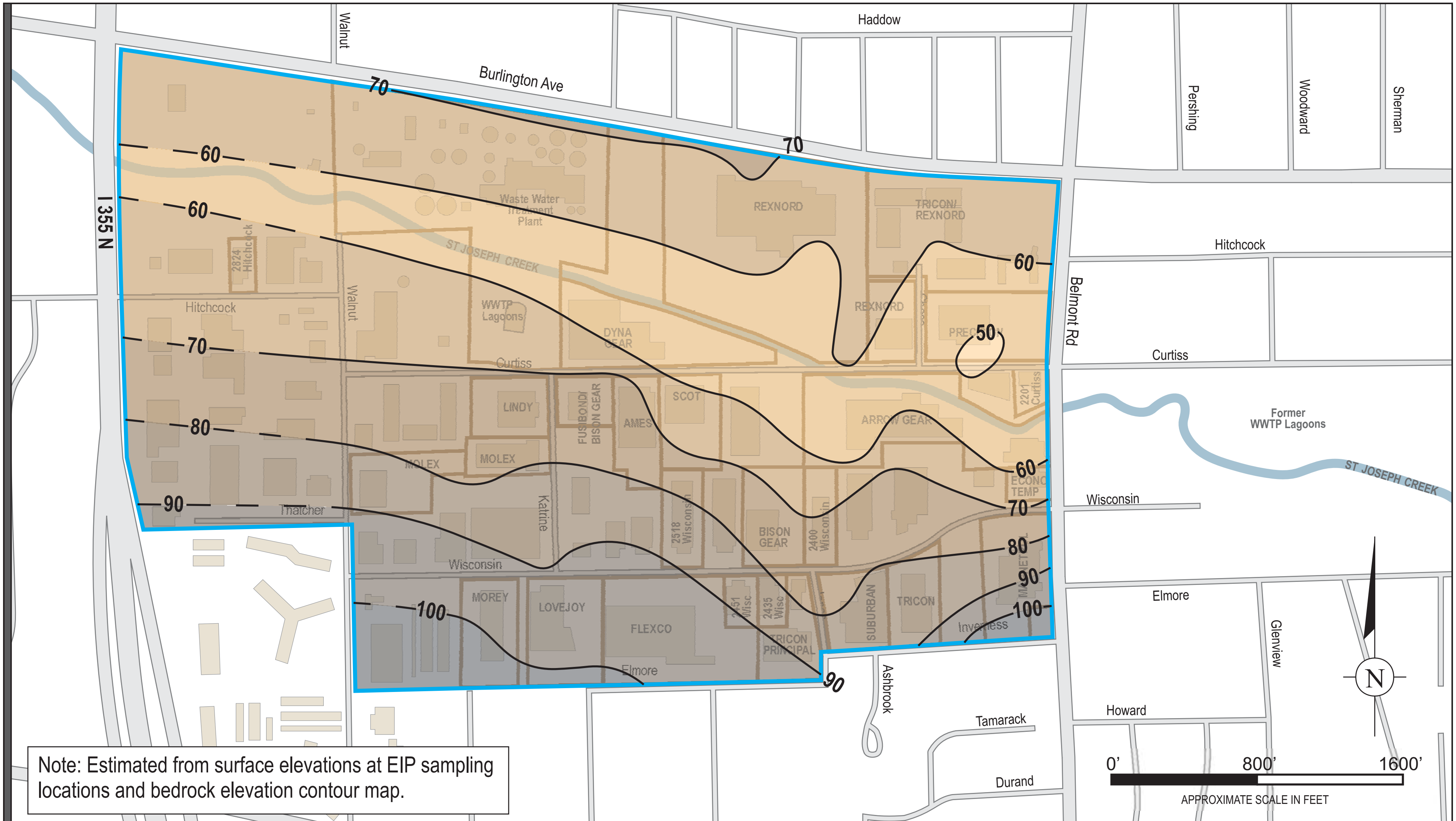

Note: Estimated from surface elevations at EIP sampling locations and bedrock elevation contour map.

Estimated Thickness of Overburden

Ellsworth Industrial Park, Downers Grove, IL

Figure 5

Fletcher Driscoll & Associates LLC

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Estimated Percent of Fine-Grained Materials

Ellsworth Industrial Park, Downers Grove, IL

Figure 6

Fletcher Driscoll & Associates LLC

DRISCOLL 00044

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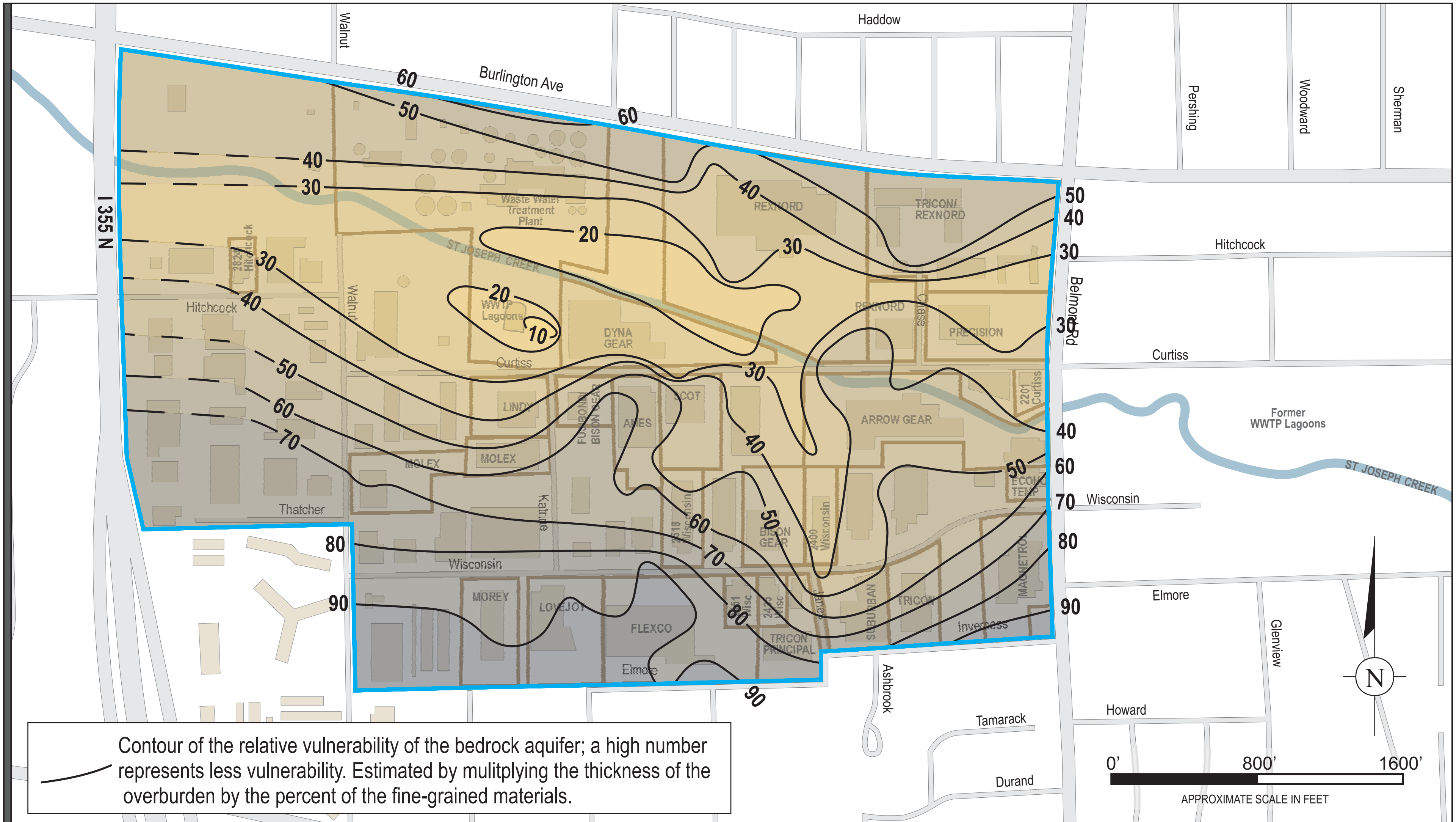


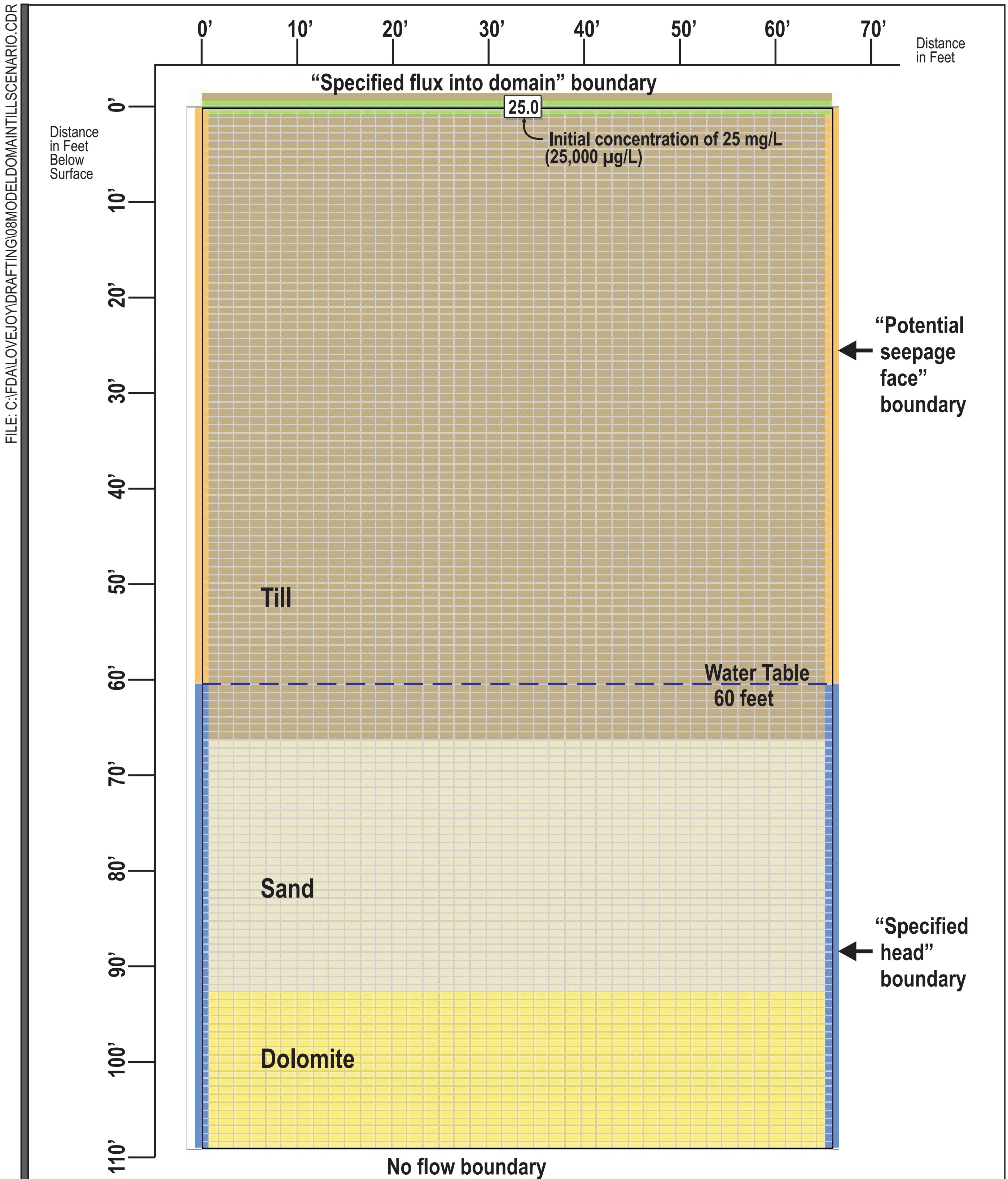
Estimated Vulnerability of the Bedrock Aquifer

Ellsworth Industrial Park, Downers Grove, IL

Figure 7

Fletcher Driscoll & Associates LLC

DRISCOLL 00045

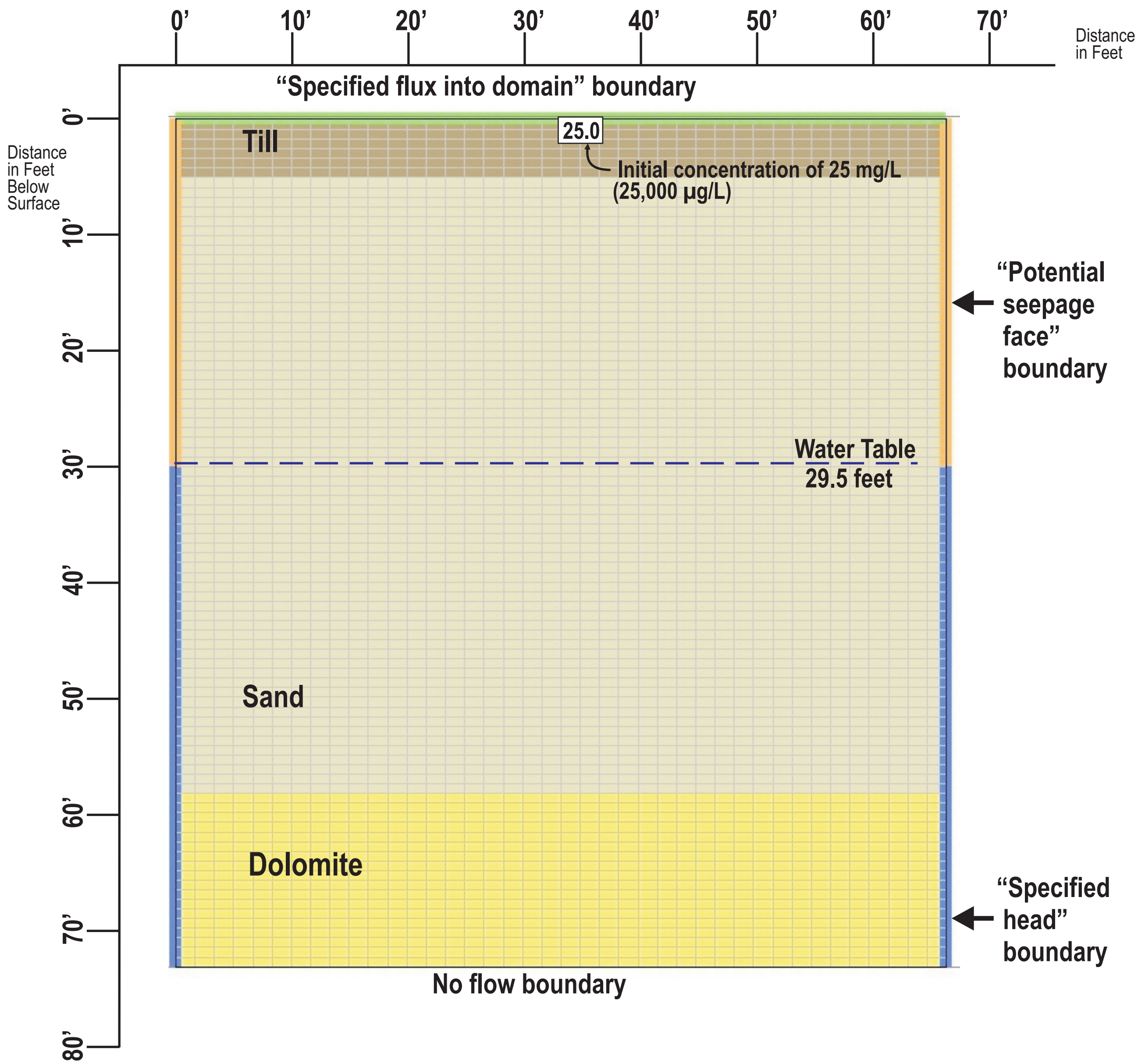


Model Domain and Boundary Conditions
Till Scenario

Ellsworth Industrial Park, Downers Grove, IL

Figure 8

Fletcher Driscoll & Associates LLC

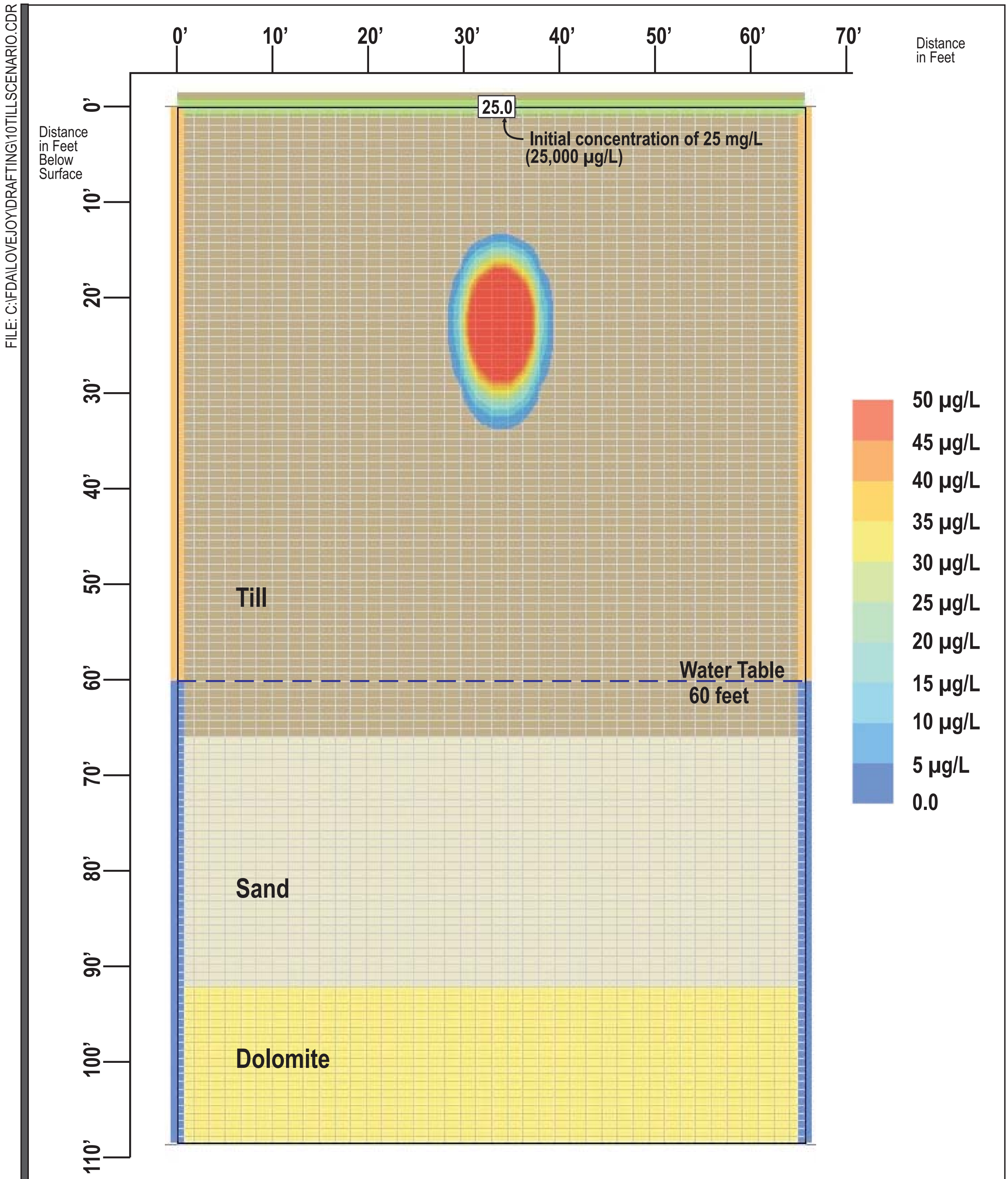


Model Domain and Boundary Conditions
Sand Scenario

Ellsworth Industrial Park, Downers Grove, IL

Figure 9

Fletcher Driscoll & Associates LLC

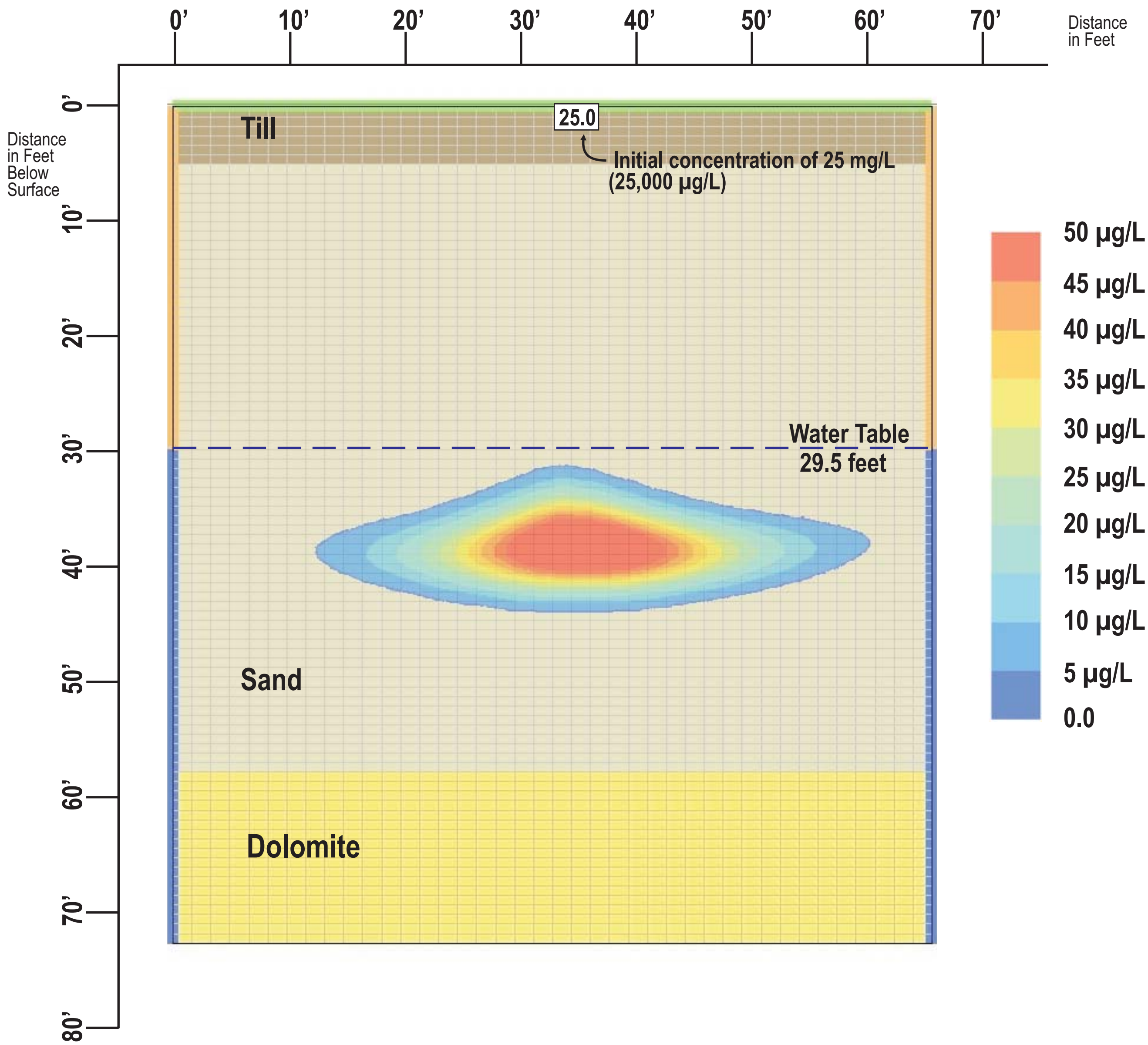


TCE Concentration at 35 Years
Till Scenario

Ellsworth Industrial Park, Downers Grove, IL

Figure 10

Fletcher Driscoll & Associates LLC

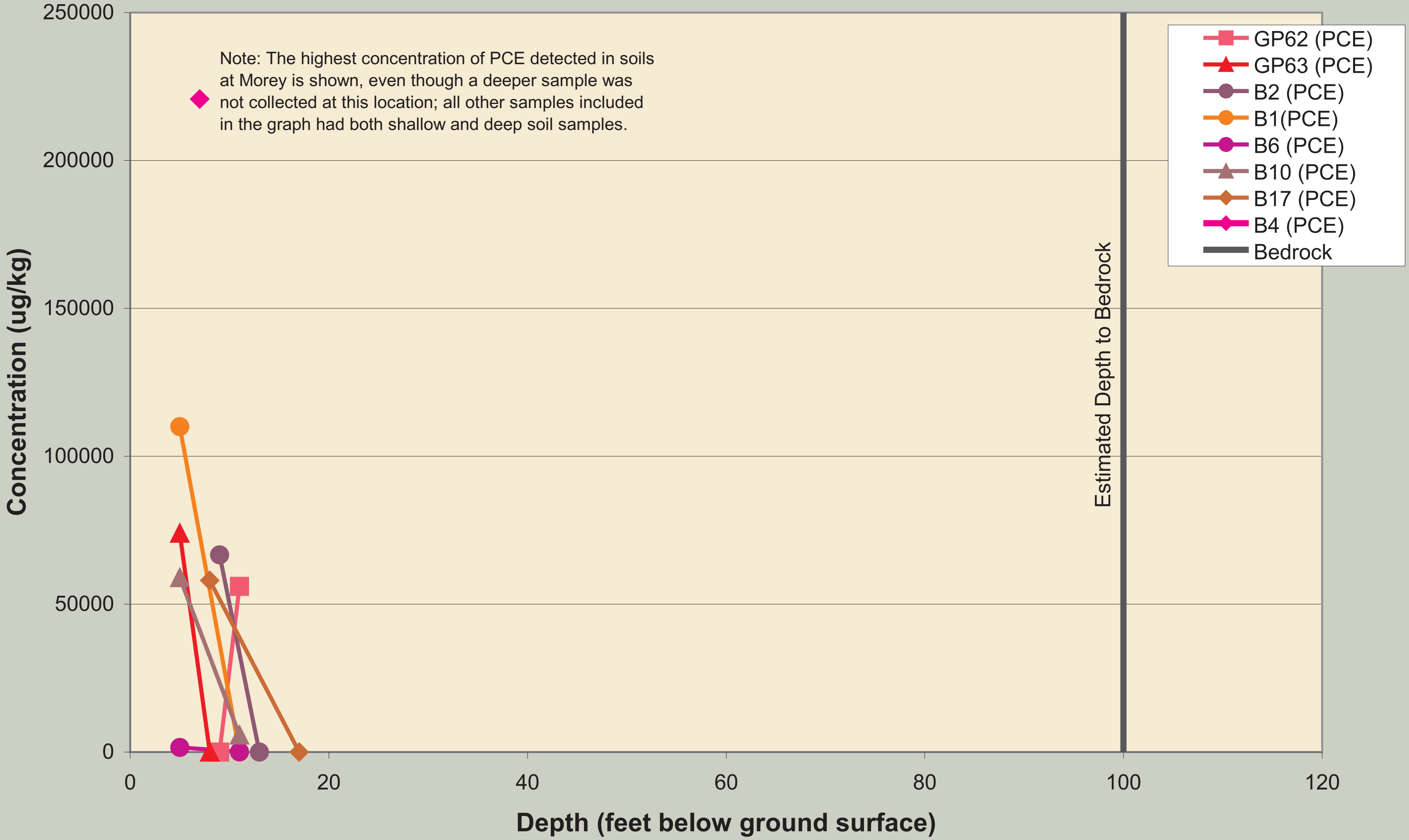


TCE Concentration at 35 Years
Sand Scenario

Ellsworth Industrial Park, Downers Grove, IL

Figure 11

Fletcher Driscoll & Associates LLC



Lack of Penetration of PCE in Glacial Tills at Morey

Ellsworth Industrial Park, Downers Grove, IL

Figure 12

Fletcher Driscoll & Associates LLC

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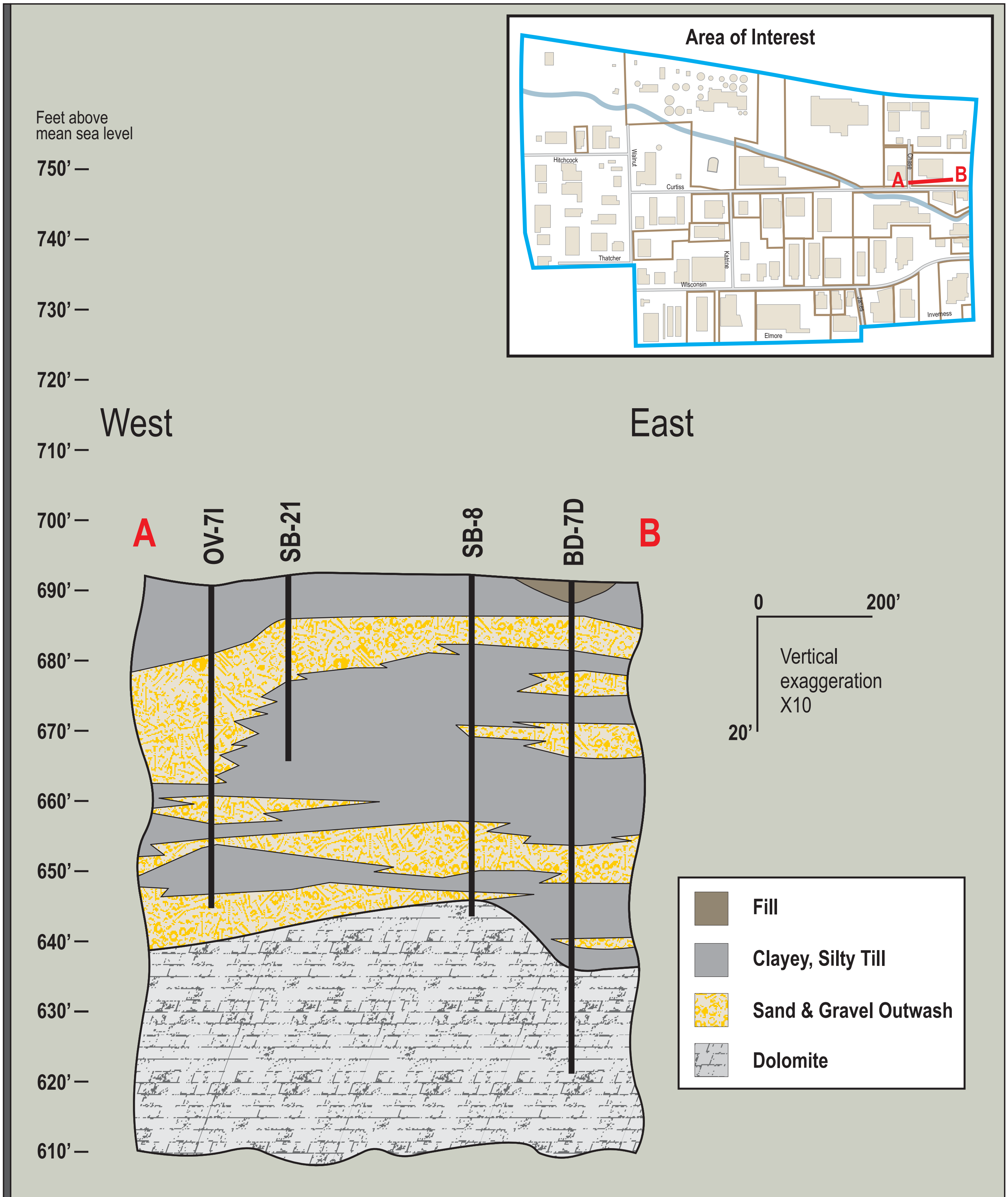

Geologic Cross Section near St. Joseph Creek
Ellsworth Industrial Park, Downers Grove, IL

Figure 13

Fletcher Driscoll & Associates LLC

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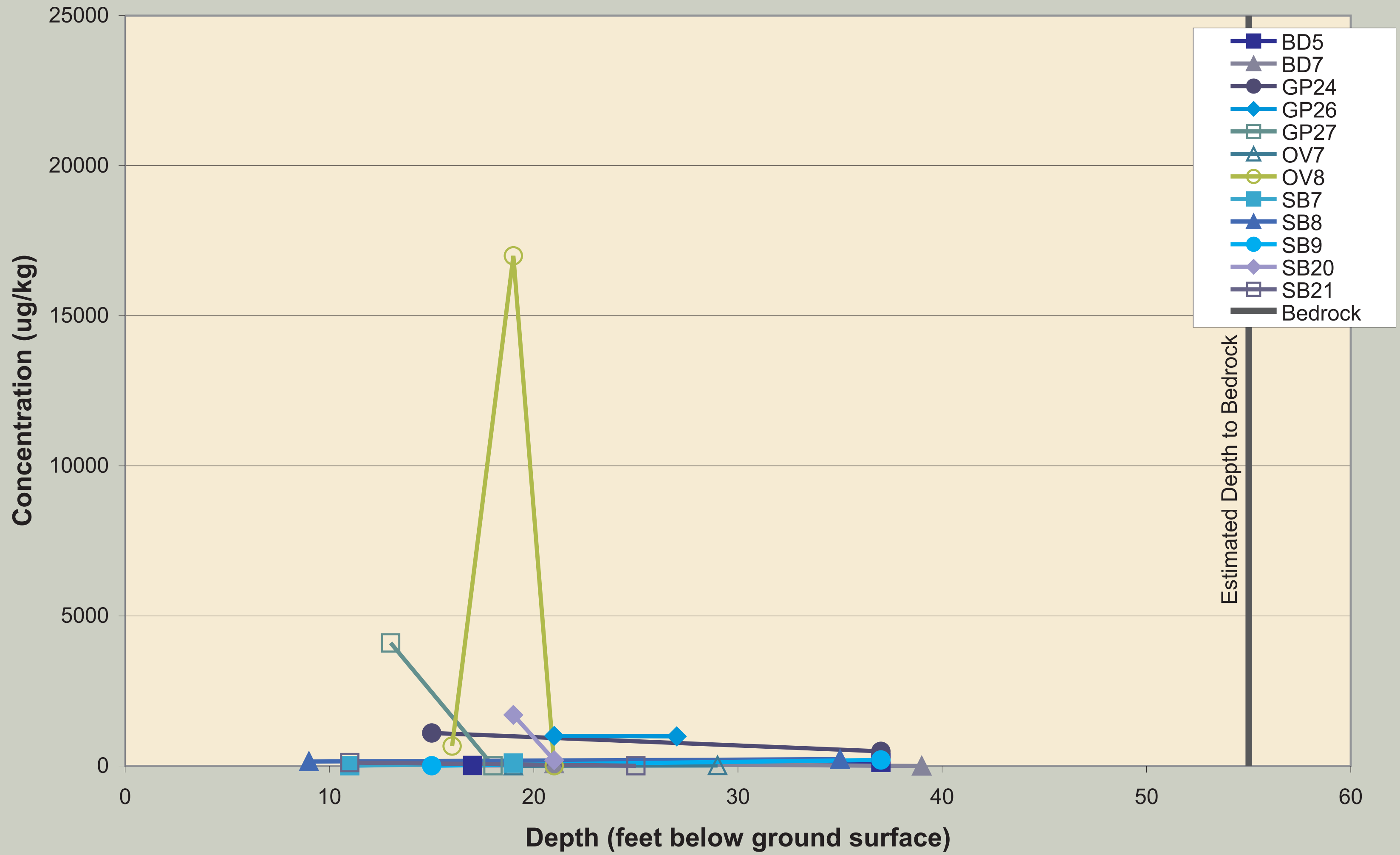
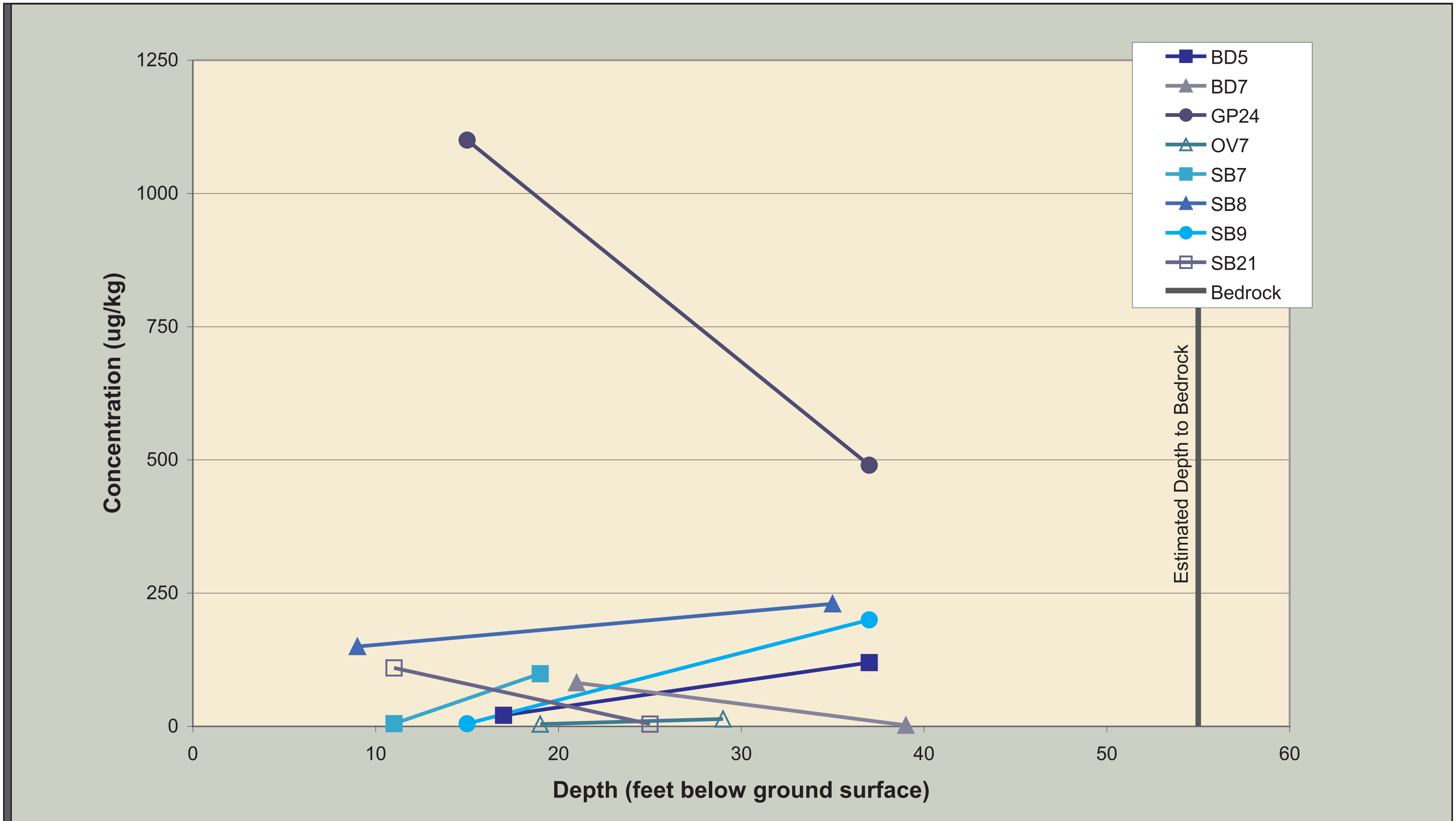


TCE Persists at Depth in Sands and Gravels near St. Joseph Creek

Ellsworth Industrial Park, Downers Grove, IL

Figure 14

Fletcher Driscoll & Associates LLC

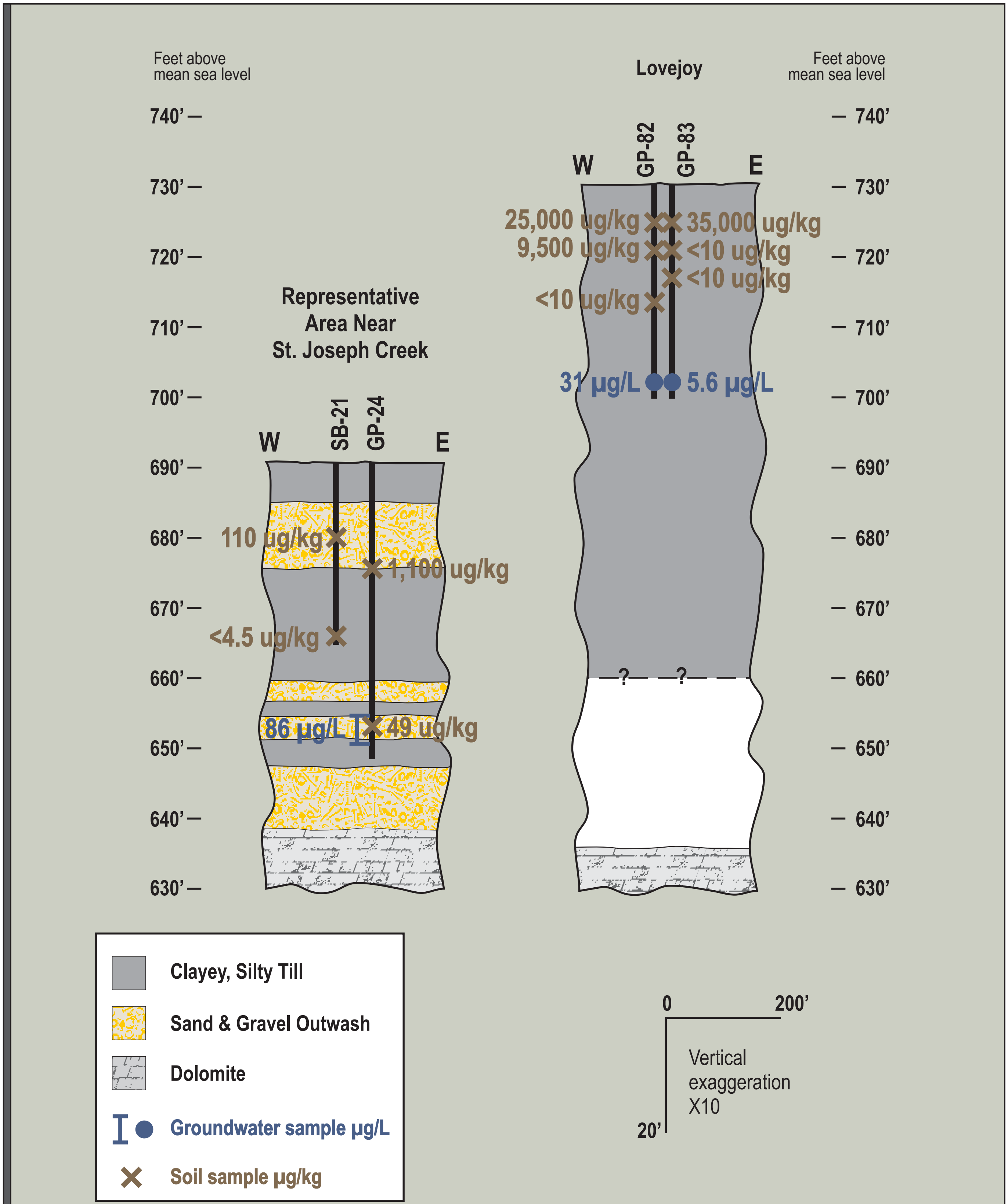


Concentrations of TCE are Present in Soils within 20' of Bedrock Near St. Joseph Creek

Ellsworth Industrial Park, Downers Grove, IL

Figure 15

Fletcher Driscoll & Associates LLC

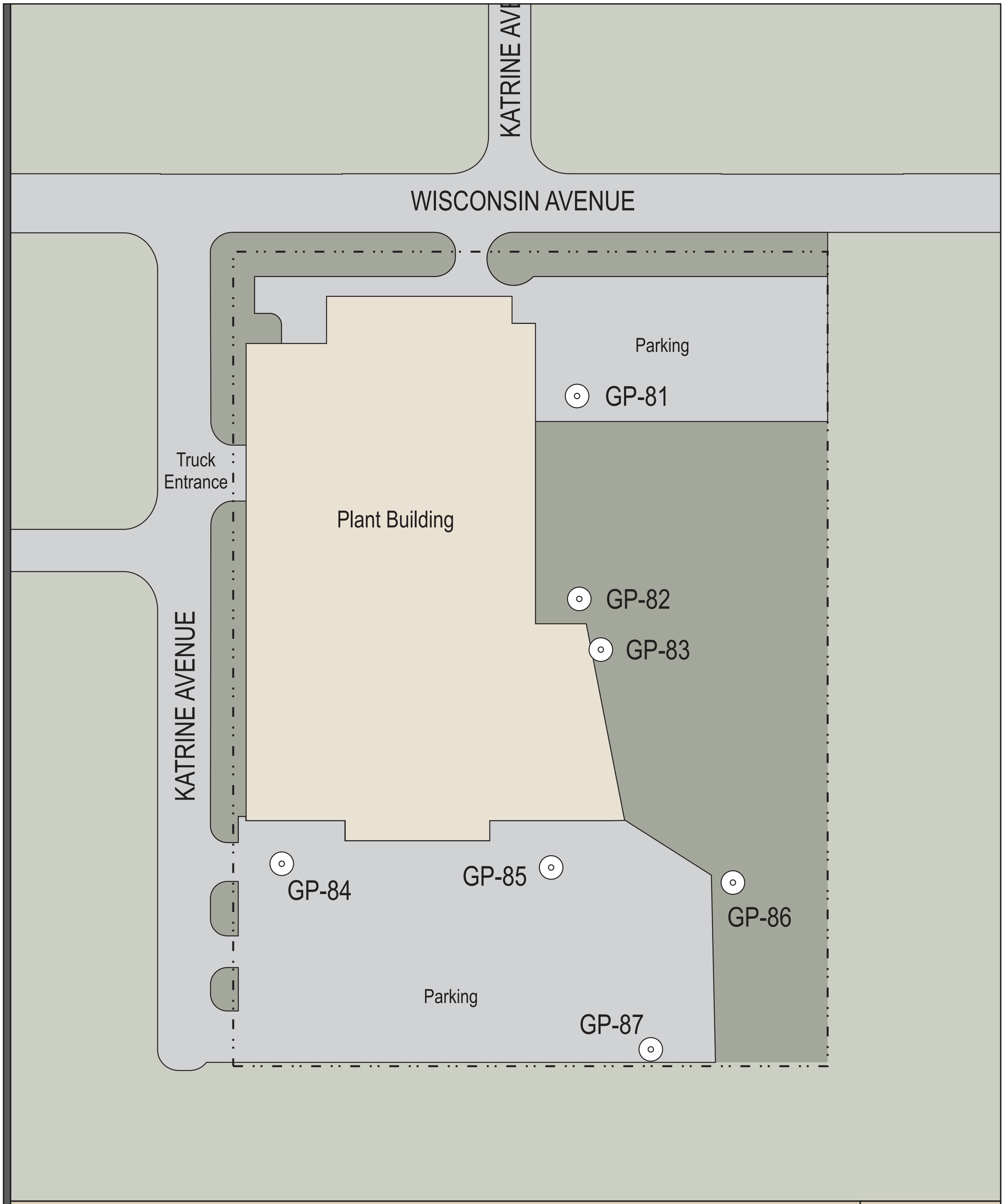


Comparison of Depth of TCE Concentrations at Lovejoy and Near St. Joseph Creek

Ellsworth Industrial Park, Downers Grove, IL

Figure 16

Fletcher Driscoll & Associates LLC



Lovejoy, Inc. Property Map

Ellsworth Industrial Park, Downers Grove, IL

Figure 17

Fletcher Driscoll & Associates LLC

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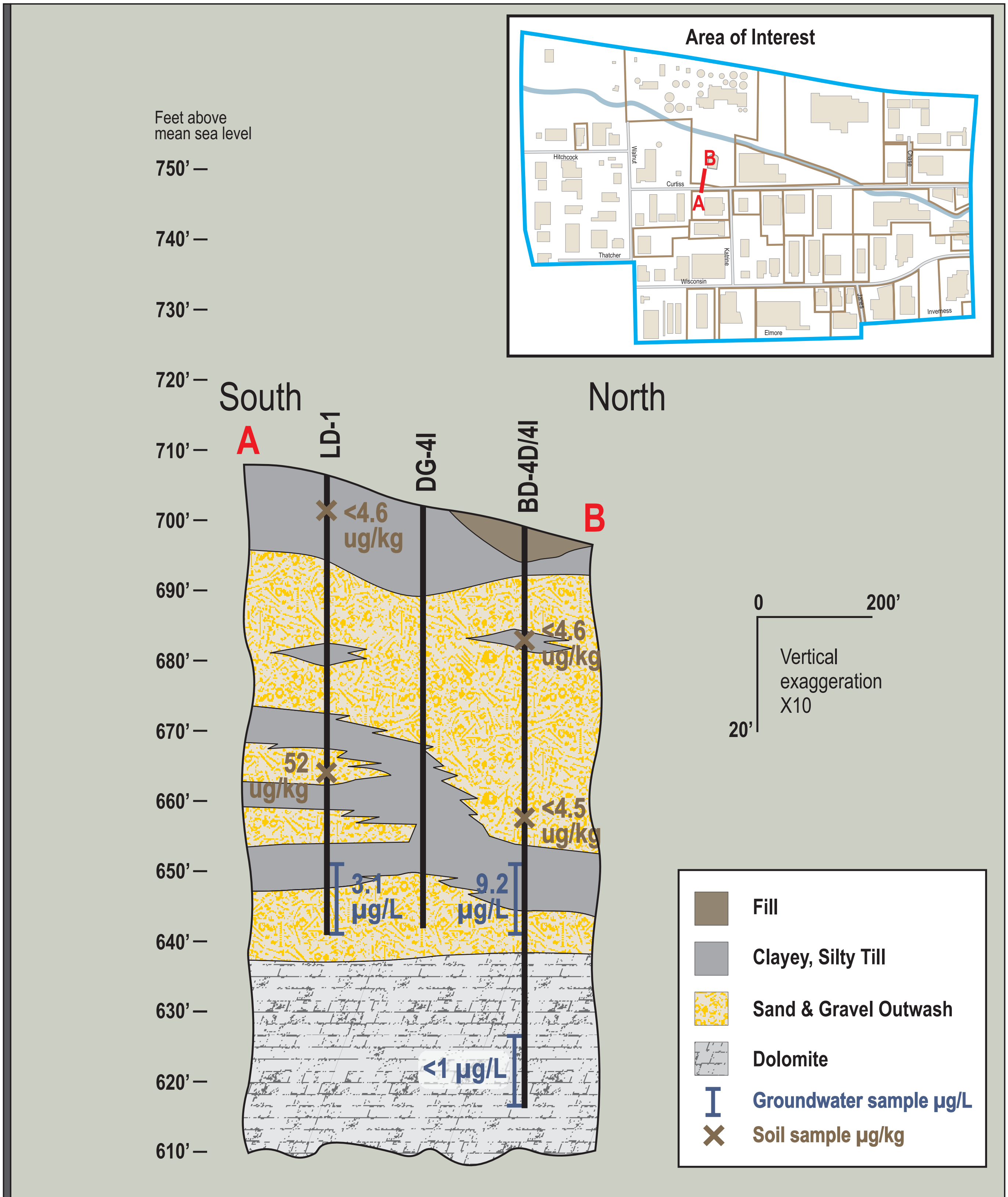

Geologic Cross Section NNW of Lovejoy Property

Ellsworth Industrial Park, Downers Grove, IL

Figure 18

Fletcher Driscoll & Associates LLC

Appendix A

Fletcher G. Driscoll
Principal Hydrogeologist

Dr. Driscoll has 30 years of experience as a hydrogeological consultant specializing in groundwater contamination, water supply development, water quality protection, and the design and construction of water supply and monitoring wells. His first expert testimony relating to fate and transport of contaminants in groundwater occurred in 1971. During the last six years, Dr. Driscoll has presented testimony at 16 trials, mediations, arbitrations, and hearings. Most of these cases involved allocating costs among multiple parties for investigation and remediation of contaminated groundwater. His experience also includes solid waste landfill siting, lake-level management, and construction and mining dewatering. Over the past 30 years, Dr. Driscoll has instructed in several hundred continuing education programs covering many geological and engineering aspects of water resources. He also is the principal author and editor of *Groundwater and Wells, 2nd Edition*, a 1,100-page full-color international reference on water well technology. This volume is the most widely used reference on well design, construction, development, and rehabilitation.

EDUCATION

PhD, Hydrogeology, minor in Civil Engineering (Hydromechanics), University of Minnesota, 1976

BA, Geology, minor in French Language, Carleton College, 1955

PROFESSIONAL REGISTRATIONS

Registered Professional Geologist, Minnesota (# 30254)

Registered Professional Geologist, Wisconsin (# 747)

PROFESSIONAL ASSOCIATIONS

American Association for the Advancement of Science

American Geological Institute

American Geophysical Union

American Water Resources Association

American Water Works Association

Arctic Institute of North America

Association of Ground Water Scientists and Engineers (NGWA)

Geological Society of America

Minnesota Groundwater Association

Special Recognition

- Recognized by the National Ground Water Association as a Life Member. (2002)

- Selected Keynote Convention Speaker for the 2001 National Ground Water Association's Ground Water Scientists and Engineer's Division. (2001)

- Elected Fellow of the Geological Society of America. (1995)

- Recognized by the Wisconsin Water Well Association for leadership in Groundwater Protection. (1991)

- Recognized in 1987 by the Association of Groundwater Scientists and Engineers (division of the National Ground Water Association) for "outstanding contributions and achievements in enlightening the groundwater community."

- Served at the request of the President on the National Drinking Water Advisory Council. This Council advises the USEPA on drinking water quality standards. (1981 - 1983)

Key Projects

- Expert witness and consultant in state and federal cases for the State of California in evaluating the original siting process, groundwater contamination, remediation efforts and cost recovery actions for the Stringfellow Superfund site in Riverside. State litigation was largest non-asbestos toxic tort case in the nation. (1988 - 2001)

- Expert witness for the City of Rialto, California in cases brought against companies for alleged pollution of drinking water resources by perchlorate. (2004)

- Consultant and potential expert witness for a large industrial firm involving VOC contamination of groundwater at a former metal working facility in Michigan. (1999 - 2004)

- Expert witness and consultant to an international firm involving VOC contamination of city wells in Urbana, Ohio. (2002 - 2004)

- Expert witness and consultant involving alleged VOC contamination of groundwater by a plastics manufacturing firm in southern Michigan. (2002 - 2003)

- Expert witness in a patent infringement case in Wisconsin involving water well development technology. (2004)

- Expert and fact witness for a Fortune 500 company in determining how remedial costs will be allocated for cleaning up a complicated karst aquifer in Missouri. (1997 - 2000)

- Expert witness for a western independent petroleum supplier in the first national litigation involving MTBE contamination of groundwater in a suit brought by the South Lake Tahoe Public Utility District, California. (2001 - 2002)

- Expert witness and consultant for high-technology company in a cost-allocation (groundwater contamination) case (mediation) involving 14 PRPs at the Stanford Research Park Superfund site in Palo Alto, California. (1993 - 1996)

- Consultant to a major Southern California engineering company advising the San Diego County Water Authority in its efforts to recharge and recover water from a local aquifer. (1998 - 1999)

- Expert witness involving creosote contamination of soils beneath a former pole-treating yard and sediments in the Fraser River, Vancouver, British Columbia, Canada. (2003-2004)

- Expert witness for the City of Tacoma, Washington in a suit alleging groundwater contamination beneath a housing development. (1998)

- Consultant and expert witness for an east coast Power Company in evaluating the effects of restoring 10,000 acres of salt water wetlands on hundreds of nearby domestic wells and septic systems in southern New Jersey and Delaware. (1998 - 2002)

- Expert witness for a Los Angeles, California industrial firm involving contamination of soils and groundwater by chromium. (1995 - 1996)

- Expert witness for a southern California water district in a suit alleging hydrocarbon contamination of groundwater. (1996 - 1998)

- Expert witness in a cost recovery case involving lead contamination of stream sediments caused by operation of a former iron foundry in New Jersey. (2004)

- Expert witness for a railroad company in its efforts to recover costs for remediating soils associated with the operation of a former creosoting facility in Minneapolis, Minnesota. (1996 - 1998)

- Expert witness and consultant for a major petroleum company in a suit alleging contamination at up to 500 service stations located in 19 eastern and southeastern states. (1994 - 1995)

- Consultant to the world's largest pump manufacturer in performing a Remedial Investigation/Feasibility Study of a former industrial site in southern Michigan. (2001 - 2002)

- Expert witness for a large chemical company in allocating remedial costs among five parties. (1997)

- Expert witness (and consultant) for a Sacramento, California developer in a suit brought against an aerospace company for contaminating a water supply valued at $20 million. (1993 - 2002)

- Expert witness for an asphalt company in a suit brought by the State of Minnesota involving alleged contamination of a public water supply by chlorinated solvents. (1996 - 2001)

- Consultant and expert witness for a large industrial firm in a suit brought by a water supply company in Indiana alleging groundwater contamination of its water supply wells. (1996)

- Expert witness for a case involving an industrial site in Irvine, California where volatile organic chemicals have contaminated groundwater both on and off site. (1994 - 1996)

- Expert witness for a 24 unit condominium that alleged the City of Seattle, Washington failed to prevent landslides that heavily damaged the condominium property. (2000 - 2001).

- Consultant to a PRP Group in southern California that is using both active remediation of VOCs at the Site and natural attenuation processes in the plume to satisfy the requirements of a consent decree. (1994 - 2004)

- Consultant to the Salt River Project (Phoenix) for development of a new well field to supply 3,500 acre-feet of water per year to the Coronado Generating Station in eastern Arizona. (1999 - 2000)

- Expert witness for the City of Tacoma, Washington in a case of groundwater contamination caused by chlorinated solvents leaking from its landfill. (1996)

- Member of peer review team that evaluated technical strategies of United States Department of Energy's Uranium Mine Tailings Remedial Action (UMTRA) project to mitigate environmental damage caused by disposal of uranium tailings at 24 sites in 11 states. (1993)

- Expert witness for a Portland, Oregon developer in a suit against a major railroad company alleging soil and groundwater contamination. (1999)

- Groundwater consultant for developer building the largest commercial and residential development in Maryland. Led public hearings on this matter for Maryland's Department of Natural Resources. (1994 - 1995)

- Expert witness for a former California drilling company in a dispute with a major environmental consulting company. (1994 - 1995)

- Remedial Investigation (RI) task leader for former chemical manufacturing site in northern Florida, where fluoride contaminated nearby city supply wells. (1992)

- Expert witness for six home-owners alleging that the City of Seattle did not prevent landslides from destroying their homes. (1999 - 2000)

- Represented a major industrial firm in the Puente Valley of southern California in mediations designed to allocate groundwater remedial costs among forty firms. (1999 - 2000)

- Expert witness in litigation involving the past use of dibromochloropropane (DBCP) in the Central Valley of California. (1992) Performed work on the same issue for a major petroleum company. (1984)

- Analyzed dewatering problem and designed successful solution for large coal mine in eastern Texas. (1991)

- Expert witness in a cost-recovery case for a large California chemical company. (1993 - 1996)

- Senior Technical Reviewer for the Remedial Investigation of the Visalia Pole Yard (Superfund site), Visalia, California. (1992)

- Advised a large engineering firm on how to handle severe maintenance problems for 1,200 dewatering wells and depressurizing drains at the world's largest pumped storage electrical generating station in Virginia. Developed chemical and physical technologies to keep wells and drains operating. (1987)

- Expert witness for injection well and water supply litigation (two suits) in Florida. (1991 - 1993)

- Expert witness for plaintiffs in Dickson County, Tennessee alleging VOC contamination of their water wells by an industrial firm. (1994 - 2004)

- Designed a slurry wall and French drain system to permanently lower the groundwater table at the LiPari Superfund site in New Jersey. (1988)

- Expert witness in a case involving lead contamination in soils, and stream and lake sediments in southern New Jersey. (1999 - 2000)

- Consultant and potential expert witness for major New Jersey dewatering contractor involving delays caused by iron bacteria in building an 8.5-mile sewer tunnel on Staten Island for the City of New York. (1992 - 1996)

- Provided advice on a dewatering design for large electric generating station in Long Beach, California. (1992)

- Expert witness in a suit involving polynuclear aromatic hydrocarbon (PAH) contamination from a manufactured gas plant and railway operation in Minneapolis. (1994 - 1995)

- Expert witness in suit involving an Indiana water supplier alleging arsenic contamination of its water supply wells by several industrial firms. (1989 - 1991)

- Developed a groundwater remediation plan for a Salt River Project electrical generating station in eastern Arizona. (1990)

- Expert witness in litigation (two cases) involving groundwater contamination originating at the Twin Cities Army Ammunition Plant, the largest Superfund site in Minnesota. (1988 - 1991)

- Evaluated the condition of a large former landfill site in a major southern California city and developed a $50 million remedial plan. (1990)

- Expert witness in evaluating the potential effect of a granite quarry development on nearby water wells in the Blue Ridge Mountains of North Carolina. (1988 - 1991)

- Expert witness for a Norwegian firm attempting to construct a 5,500-home development on the Potomac River south of Washington, D.C. (1998)

- Designed a slurry wall and drain system to permanently lower the groundwater table beneath a state-of-the-art sanitary landfill site in Wisconsin. (1988)

- Expert witness in litigation involving iron problems in a Wisconsin public water supply well. (1991)

- Designed a 5,300-foot deep high-capacity water well for a Wyoming coal company. (1989)

- Studied sources and fate of PCBs in San Diego Harbor originating from two large industrial sites. (1990)

- Expert witness for two cases in South Dakota involving groundwater contamination of water wells caused by a petroleum spill. (1987)

- Expert witness and consultant in remediation/mediation/litigation involving a 1984 petroleum spill and the resulting contamination of water wells constructed in basalt in northern Minnesota. (1994 - 1998)

Research/Writer

- Served as principal author and editor for Groundwater and Wells, 2nd Edition, a 1,100-page, full-color international reference on water well technology, published in 1986 by Johnson Division. Approximately 60,000 copies in print.

- Directed research on the rate of corrosion and incrustation of water well screens as a function of inlet velocity for Johnson Division (1984-1986), and the rate of carbonate incrustation of drain holes for Virginia Electric Power Company (1987).

- Author or co-author of 15 scientific or technical publications.

Management

- Former Vice President and Senior Expert for Geraghty & Miller, Inc. Former Director of the Groundwater Consultants Division and Director of Training and Professional Development. Responsible for creating ongoing mentoring program for Geraghty & Miller scientists, as well as development of technical training materials, implementation of training programs, and professional development of the 1,100-person staff.

- Organized, administered, and helped teach 15 engineering short courses annually for the University of Wisconsin-Extension. (1981 - 1984)

- Managed 8-person technical engineering sales staff for central part of North America for Johnson Division. (1978 - 1980)

- Directed Physical Geology Program at University of Minnesota (Minneapolis). Increased enrollment from 900 to 1,500 students annually. (1973 - 1975)

Teaching

- Ongoing lecturer in professional engineering programs for University of Wisconsin-Extension, University of Florida-Extension, California Bar Association, University of Minnesota-Extension, University of California, Geraghty & Miller, professional societies, state governments, business, and consulting groups.

- Served as a member of federal EPA training team for the RCRA enforcement program during 1986 and 1987.

- Mellon Teaching Fellow, Carleton College. (1975 - 1976)

- Taught college-level courses in water resources, physical geology, glacial geology, water well design and construction, and water well hydraulics.

- Voted outstanding lecturer in Physical Geology at the University of Minnesota in 1973 and 1974.

Publications

Driscoll, Fletcher G., 1998. Groundwater Modeling in Environmental Litigation: The Opportunities and the Problems. Presented at the National Environmental Forensic Conference: Chlorinated Solvents and Petroleum Hydrocarbons, University of Wisconsin, Tucson, AZ, 13p.

Driscoll, Fletcher G., Rolf D. Miller and Susan M. Mullin, 1995. Solving Complex Hydrogeologic and Contamination Problems using Computer Models: Visualization of Scientific Data. Presented at 1996 Environmental Law Update for Clients, Squire, Sanders & Dempsey, Columbus, OH, 22p.

Driscoll, Fletcher G., 1993. Precautions in Using the Capture-Zone Equation. Proceedings of seminar by Geotechnical Group, Metropolitan Section, American Society of Civil Engineers, United Engineering Center, New York, NY, 21p.

Driscoll, Fletcher G., 1993. Defending Your Client in Cases of Groundwater Contamination. Proceedings of Environmental Law Institute, Environmental Law Section of the State Bar of California, October 21-24, Yosemite, CA, 23p.

Driscoll, Fletcher G., 1993. Clarifying the Scientist's Role in the Groundwater Remediation Process. Presented at 1992 Institute of Environmental Education, GSA Today, Vol. 3, No. 9, September, pp 231-233.

Driscoll, Fletcher G., 1990. Project Management Manual. Prepared for Geraghty and Miller, Inc., 561p.

Driscoll, Fletcher G., 1988. Geologic Considerations in the Design of Groundwater Monitoring Systems. Hazardous Waste: Crime and Punishment, Environmental Law Institute. Presented by Dr. Robert D. Morrison, Chicago, IL, 20p.

Driscoll, Fletcher G., 1986. Groundwater and Wells, Second Edition. Johnson Filtration Systems, Inc., St. Paul, MN, 1,089p.

Driscoll, F. G., D. T. Hanson, and L. J. Page, 1980. Well efficiency project yields energy-saving data, Part I. Johnson Drillers' Journal, Johnson Division, St. Paul, MN, March/April, 4p.

Driscoll, F. G., D. T. Hanson, and L. J. Page, 1980. Well efficiency project yields energy-saving data, Part II. Johnson Drillers' Journal, Johnson Division, St. Paul, MN, May/June, 8 p.

Driscoll, F. G., D. T. Hanson, and L. J. Page, 1980. Well efficiency project yields energy-saving data, Part III. Johnson Drillers' Journal, Johnson Division, St. Paul, MN, September/October, 5p.

Driscoll, F. G., D. T. Hanson, and L. J. Page, 1981. Well efficiency project yields energy-saving data, Part IV. Johnson Drillers' Journal, Johnson Division, St. Paul, MN, 1st Quarter, 12p.

Driscoll, Fletcher G., 1980. Formation of the neoglacial surge moraines of the Klutlan Glacier, Yukon Territory, Canada. Quaternary Research 14, pp. 19-30.

Driscoll, Fletcher G., 1980. Wastage of the Klutlan ice-cored moraines, Yukon Territory, Canada. Quaternary Research 14, pp. 31-39.

Driscoll, Fletcher G., 1978. Blasting – It Turns Dry Holes into Wet Ones! Johnson Drillers' Journal, Johnson Division, St. Paul, MN, November-December, 4p.

Driscoll, Fletcher G., 1974. Meltout rates of ice-cored moraines. Geological Society of America abstracts, Vol. 6, No. 7.

Matsch, C. L. and F. G. Driscoll, 1973. Drift lithology and glaciology of the Des Moines Lobe in southern Minnesota. International Union for Quaternary Research, IX INQUA Congress, Symposium 10, Christchurch, New Zealand.

Expert Testimony (preceding 4 years)

2003

Expert report for Beazer East, Inc. v. Atlantic Industries Limited et al, Vancouver, British Colombia, Canada.

Mediation testimony for Thermofil, Inc. v. Haigh Industries et al v. International Telephone and Telegraph Corp., Brighton, Michigan.

2004

Deposition for TPI of Texas, Inc. v. Bantivoglio Investiment Company et al., Millville, New Jersey.

Expert Report and Affidavit for William C. Frazier, Frazier Industries, Inc., and Airburst Technologies, LLC v. Layne Christensen Company and ProWell Technologies, Ltd.

2005

Deposition for William C. Frazier, Frazier Industries, Inc., and Airburst Technologies, LLC v. Layne Christensen Company and ProWell Technologies, Ltd.

2006

Trial Testimony for William C. Frazier, Frazier Industries, Inc., and Airburst Technologies, LLC v. Layne Christensen Company and ProWell Technologies, Ltd.

Appendix B

References

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Berg, R.C, 2001, Aquifer sensitivity classification for Illinois using depth to uppermost aquifer material and aquifer thickness, Illinois State Geological Survey Circular 560, 14p.

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Illinois Environmental Protection Agency, 1998, RCRA Inspection Report, April 17, 1998.

Illinois Environmental Protection Agency, 1998, Violation Notice L-1998-01312, June 25, 1998.

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Kay, B. and Ryan, W.J. (U.S. EPA), 2004, Technical Memorandum: Results of Initial Hydrogeologic Assessment, January 14, 2004.

Krumbein, W.C., and Sloss, L.L., 1963, Stratigraphy and Sedimentation: W.H. Freeman and Company, 660p.

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Ruland, W.W., Cherry, J.A., and Feenstra, S., 1991, The Depth of Fractures and Active Ground-Water Flow in a Clayey Till Plain in Southwestern Ontario, *Ground Water*, vol. 29, no. 3., pp. 405-417.

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Weston Solutions, Inc., August 2002, Phase II Site Assessment Report, Downers Grove, DuPage County, Illinois

Weston Solutions, Inc., August 2004, Data Evaluation Summary Report, Downers Grove, DuPage County, Illinois

Weston Solutions, Inc., 2006, Preliminary Planning Report, Ellsworth Industrial Park Site, Downers Grove, DuPage County, Illinois, Revisions 0 and 1.

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Zeizel, A.J., Walton, W.C., Sasman, R.T., and Prickett, T.A., 1962, Ground-Water Resources of DuPage County, Illinois, Illinois State Water Survey and Illinois Geological Survey Cooperative Ground-Water Report 2, 103p.

Appendix C

Thomas L. Davis
Senior Hydrogeologist

Mr. Davis has 29 years of experience providing hydrogeologic analyses for clients throughout the world on projects involving water supply, construction dewatering, and contaminant transport. He is currently active in hydrogeologic and contaminant-transport analyses for large-scale litigation and construction projects involving surface-water, groundwater, and well hydraulics and well design, installation, and rehabilitation.

EDUCATION

BS, Geology, University of Minnesota, 1974

PROFESSIONAL REGISTRATIONS

Registered Professional Geologist, Minnesota (# 30678)

PROFESSIONAL ASSOCIATIONS

Association of Ground Water Scientists and Engineers

American Water Works Association

Minnesota Ground Water Association

Fields of Specialization

- Groundwater flow system analysis
- Aquifer test design and data analysis
- Contaminant transport analysis for hazardous waste and water supply litigation
- Construction dewatering technology
- Design, construction, development and rehabilitation of all types of wells

Key Projects

Consulting

- Analyzed volatile organic chemical (VOC) loading to groundwater from vadose zone sources at an industrial facility in eastern Michigan using a vadose zone transport model (VLEACH) and evaluated plume development using a groundwater flow and transport model (MODFLOW/MT3D). Results were used to assess responsibility in a multi-party mediation.
- Modeled MTBE transport in groundwater using MODFLOW/MT3D to determine whether high-capacity municipal wells near Lake Tahoe would be affected by releases of gasoline. Analysis resulted in a successful settlement for a client in a multi-party, high-profile litigation.
- Analyzed the effects that an abandoned industrial sewer and an operating storm sewer had on the spread of metals and VOCs at a Superfund site in southern Michigan.
- Created a multi-layer MODFLOW model to evaluate pumping well performance and capture zone extent for a multi-well extraction system for a site in southern California.
- Modeled contaminant transport using an analytical model, assessed capture zones with an established finite-element model, and analyzed transport models (analytic-element and finite-

difference) developed by opposing parties for a Fortune 500 client in a successful multi-party mediation in southern California.

- Constructed a hydrologic model with the USGS code HSPF to simulate the transport of lead-contaminated sediments in an ephemeral stream and into a lake over a 50-year period in support of litigation regarding a former foundry.

- Analyzed the effects of salt-marsh rejuvenation on groundwater flow and water quality for a large power utility on the mid-Atlantic coast.

- Successfully negotiated with the state pollution control agency to reduce requirements for hydraulic testing and contaminant transport modeling at a large petroleum terminal in Minnesota.

- Analyzed the effects of high-volume groundwater pumping on existing wells, contaminant movement, and salt-water intrusion from the Potomac River and the Atlantic Ocean in support of a groundwater appropriation permit for the largest proposed residential development in Maryland.

- Evaluated geologic and hydraulic data to determine groundwater flow conditions, fate and transport of VOCs and hydrocarbons, and hydraulic capture by extraction wells at a site in complex karst terrane in southwestern Missouri. The analysis supported an allocation plan for a Fortune 500 company seeking cost recovery in a multi-million dollar arbitration.

- Provided technical guidance on pumping-test analysis, groundwater flow modeling (using finite-difference and analytic-element codes) and extraction system design for a local consultant and a large municipality in Washington State. The successful multi-well extraction system prevented contaminants from a municipal landfill from reaching nearby municipal supply wells.

- Evaluated client compliance with the National Contingency Plan during investigation and remediation at a former rail yard contaminated with PAHs.

- Analyzed geophysical data and other geologic data following a gasoline spill in Southeastern Minnesota to determine groundwater flow and contaminant transport conditions in karst terrane.

- Provided design and installation guidance for over one hundred deep sandstone wells and prepared a plan for rehabilitating dozens of existing wells for an international contractor working in northern Africa. The wells averaged 2000-feet deep with design capacities exceeding 1500 gallons per minute.

- Modeled groundwater flow near the St. Croix River in Minnesota to demonstrate whether VOCs from an industrial site had reached water supply wells. Subsequently, successfully negotiated with the state pollution control agency to end monitoring at the site and to remove it from the priorities list.

- Analyzed the causes of rapid plugging by sulfate-reducing bacteria in dewatering wells for a major dewatering contractor involving a complex subway expansion project in Washington, D.C. Designed a comprehensive rehabilitation and maintenance program for sustaining well yield.

- Evaluated the unusual spreading of VOCs around an oil well servicing and chemical storage facility in Texas and developed conclusions about the causes of the odd contaminant behavior in support of litigation.

- Constructed a three-dimensional, multi-phase flow and transport model using Porflow (finite-difference computer code) to represent subsurface conditions in multiple hydrogeologic terranes for petroleum facilities in 19 states. Tracked the long-term spread and attenuation of hydrocarbon spills through the vadose zone and into groundwater. Prepared 3-D computer visualization of results for a high-profile litigation involving a major oil company.

- Assessed the effect of several high-capacity municipal wells on the spread of an arsenic plume at a former manufacturing facility in northern Indiana.

- Analyzed the cause of rapid iron-bacteria plugging of dewatering wells for potential testimony for major dewatering contractor involving an 8.5-mile sewer tunnel project on Staten Island, New York.

- Analyzed a long-term pumping test in fractured metamorphic rocks, assessed the groundwater flow system, and provided conclusions regarding the long-term effects of pumping for a developer building a large commercial and residential development in Maryland.

- Analyzed the applicability of CERCLA regulations in a suit involving wastes from a former manufactured gas plant and railway operation in Minnesota.

- Modeled groundwater flow patterns, analyzed contaminant transport, and critically evaluated a multi-layer flow and transport model in support of expert testimony for state and federal cases for the State of California in evaluating the original siting process, groundwater contamination, and remediation efforts for the Stringfellow Superfund site. At one time, the largest non-asbestos toxic tort case in the nation.

- Analyzed hydrogeological conditions and contaminant attenuation for a high-technology company in a cost-allocation case involving 14 PRPs at the Stanford Research Park Superfund site in Palo Alto, California in support of expert testimony.

- Served as member of quality-assurance review team that evaluated technical strategies of the United States Department of Energy's Uranium Mine Tailings Remedial Action (UMTRA) project to mitigate environmental damage caused by disposal of uranium tailings at 24 sites in 11 states.

- Supported expert testimony regarding the local hydrogeologic system for litigation involving the Twin Cities Army Ammunition Plant, the largest Superfund site in Minnesota.

- Evaluated the hydraulic effects (including salt-water intrusion) of deep-aquifer pumping on Bainbridge Island, Washington.

- Evaluated regulatory compliance of a groundwater monitoring system at a RCRA facility in St. Paul, Minnesota.

- Designed a well rehabilitation scheme for deep water-supply and steam-injection wells for a large oil company near Lloydminster, Saskatchewan, Canada.

- Designed a groundwater dewatering system for facility expansion at the Arecibo Water Treatment Plant, Arecibo, Puerto Rico.

- Provided design and construction consultation for the first installation of a horizontal collector system by the Fehlman method that used continuous-slot screens. The system was successfully installed under the Oldman River and provided a 14-mgd water supply for the city of Ft. McLeod, Alberta, Canada.

- Designed wells and provided installation guidance for a 7-mgd municipal well field for Sioux Falls, South Dakota.

- Evaluated installation procedures for pressure-relief, monitoring, and instrumentation wells for the U.S. Army Corps of Engineers installed in the riverbed for a lock and dam construction in the Mississippi River near St. Louis, Missouri.

Management

- Managed 14 technical staff and 4 support staff in the Minneapolis office of Geraghty & Miller, Inc (now ARCADIS Geraghty & Miller).

- Managed the geophysical products group of Johnson Filtration Systems (Johnson Screens) trained international clients and staff to apply techniques and interpret geophysical data, interpreted data for clients, and directed product marketing world-wide.

- Managed sediment- and water-analysis laboratory staff for Johnson Filtration Systems. Also managed a group of five engineers, geologists, and technical sales representatives in the central United States with a sales volume of $6 million.

Training/Writing

- Served as trainer on hydrogeologic characterization of hazardous waste sites for the federal EPA training team for the RCRA Enforcement Division, Office of Waste Programs Enforcement.

- Helped develop and complete several internal technical training videos for Geraghty & Miller staff.

- Co-developed and co-produced a groundwater education video for the Edison Electric Institute.

- Taught at over 100 seminars and short courses and continues to lecture on site investigation, hydrogeologic analysis, well design and installation, groundwater protection, dewatering technology, groundwater resource exploration, collection and interpretation of geophysical data, and aquifer testing, for many professional groups, public agencies, and universities.

- Served as principal technical reviewer and contributed sections on well hydraulics and pump maintenance for Groundwater and Wells, 2nd Edition, a 1,068-page, full-color, international reference on groundwater development and water-well technology, published in 1986 by Johnson Division.

- Co-authored the guidance manual for designing and conducting pumping tests for the former Groundwater Division of Geraghty & Miller.

Selected Publications and Presentations

- Thomas L. Davis, "Characterizing Subsurface Geologic Conditions" and "The Physics of Subsurface Fluid Flow," presented at "Technical Essentials for Successful Environmental Decision Making", University of Wisconsin - Madison, College of Engineering, June 25 - 27, 1997, Madison, WI.

- Thomas L. Davis, "Interpreting Pumping Tests from Unconfined Aquifers and with Partial Penetration Effects," presented at "Groundwater Flow and Well Hydraulics", University of Wisconsin - Madison, College of Engineering, March 19 - 22, 1996, Madison, WI.

- Thomas L. Davis, "Implementing Groundwater Monitoring," presented at "Sanitary Landfill Design", University of Wisconsin - Madison, College of Engineering, January 25 - 27, 1994 and February 8 - 10, 1995, Madison, WI.

- Thomas L. Davis, "Techniques to Characterize Hydrogeologic Conditions at Waste Management Facilities," presented at "RCRA Ground-Water Monitoring Enforcement: Use of the TEGD and COG," sponsored by the RCRA Enforcement Division, Office of Waste Programs Enforcement, January 5 - 8, 1987, Philadelphia, PA.

- Thomas L. Davis, "Shallow Exploration and Groundwater Pollution," presented at the Thirteenth Annual Shallow Exploration Drillers Clinic, Feb. 23 - 24, 1978, Sioux Falls, SD.